No. 1850
Vol. XLV

1/-

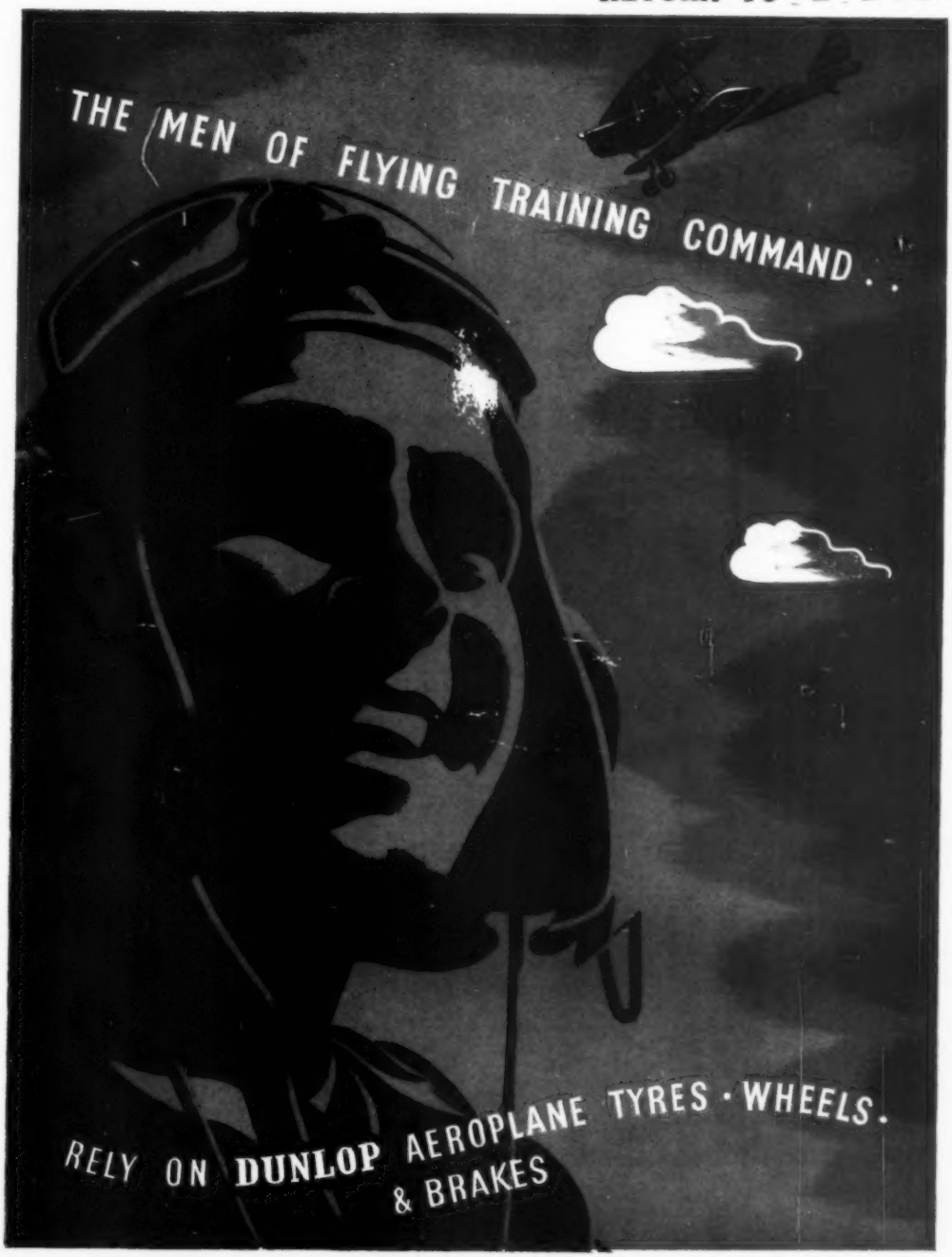
FLIGHT

and The AIRCRAFT ENGINEER

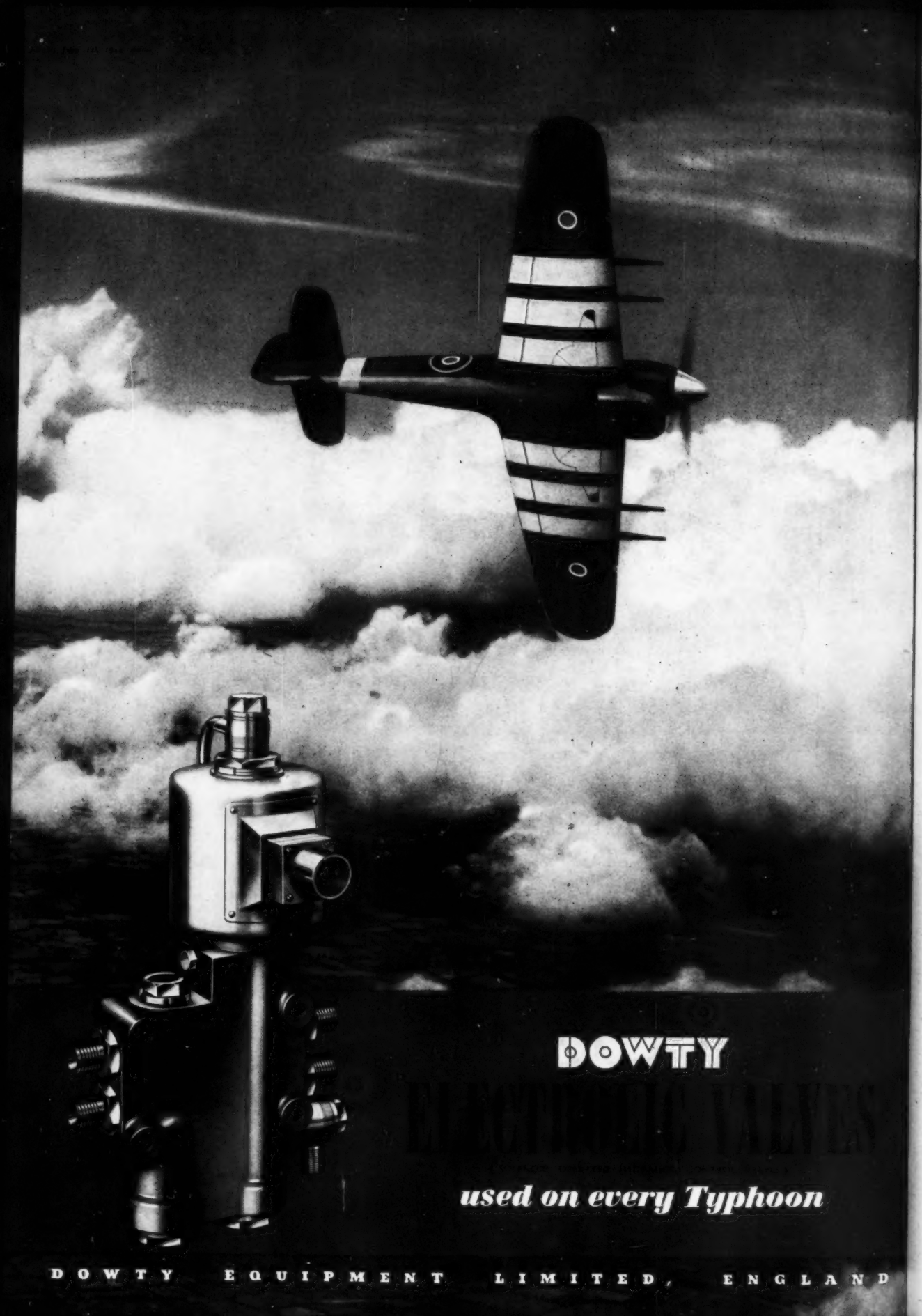
OFFICIAL ORGAN OF THE ROYAL AERO CLUB

JUNE 8th, 1944

RETURN TO "E" LIBRARY



3H/61C


DOWTY
used on every Typhoon
DOWTY EQUIPMENT LIMITED, ENGLAND

FLIGHT and The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

Editor C. M. POULSEN

Managing Editor G. GEOFFREY SMITH, M.B.E.

Chief Photographer JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

COVENTRY :	BIRMINGHAM, 2 :	MANCHESTER, 3 :	GLASGOW, C.2 :
8-10, CORPORATION ST.	GUILDHALL BUILDINGS, NAVIGATION ST.	260, DEANSGATE	26B, RENFIELD ST.
Telegrams: Autocar, Coventry.	*Telegrams:* Autopress, Birmingham.	*Telegrams:* Iliffe, Manchester.	*Telegrams:* Iliffe, Glasgow.
Telephone: Coventry 5210.	*Telephone:* Midland 2971 (5 lines).	*Telephone:* Blackfriars 4412.	*Telephone:* Central 4857.

Registered at the G.P.O. as a Newspaper.

No. 1850. Vol. XLV. June 8th, 1944 Thursdays, One Shilling.

The Outlook

Seeing is Believing

EDWARD BOWYER, in the third of his series of articles recording his impressions of a 26,000 miles tour by air through Africa, India, America and Canada, this week touches upon points which merit the very closest study by all who are connected with the design and manufacture of aircraft for long-distance overseas air routes. Many are the desirable and undesirable features to which he calls attention, and one sentence deserves to be printed in large letters on wall cards and hung up in all those of our aircraft factories and offices which have any ambitions in the direction of commercial aircraft. It reads as follows:

> "In my view, few better services could be rendered the British aircraft industry by the Government than the utmost help in facilitating visits by British designers and engineers to the main operating centres abroad. It will obviously be difficult for key men to leave their factories while the war remains at its peak, but as soon as possible British technicians should be sent out in swarms. They will learn more in a few hours of discussion with the men on the spot than in months of study of reports and memoranda. *The mind is not sufficiently receptive to the problems of great heat when the thermometer outside the drawing office window stands at 60 to 70 deg. Fahrenheit.*"

That paragraph, and particularly the italicised sentence, contains a fundamental truth which is far too rarely realised. If it were really brought home to firms in the industry, so that sufficient pressure could be brought to bear on the Molochs of Millbank, the benefit to British aviation would be incalculable. There is no reason for delaying. To argue that the necessary men could not be spared (although Mr. Bowyer accepts the argument, more out of politeness than anything else we imagine) is plausible but futile. There is not a firm in the country which could not somehow manage for a matter of three or four months without a man suitable to report on the operational and maintenance aspects. Unless we do something of the sort we shall risk producing some very nice aircraft which nobody will buy.

Pressure Cabins

ALREADY before the outbreak of the present war we on *Flight* held the view that pressure cabins would become essential, not merely for so-called stratosphere flying, but on long-distance routes at much lower heights. We based our opinions on the assumption that once an air passenger had tried the comfort of such a cabin he would never be content to put up with the ear-splitting air pressure changes of the ordinary leaky contraption. In competition on the routes, that company which could advertise pressure cabins would scoop the traffic.

We are extremely interested to learn that on his travels Mr. Bowyer found many practical experts who also hold that view. It is no manner of use arguing that the weight cannot be afforded. It will have to be afforded, even if certain other aids to comfort have to be sacrificed. It is small consolation to a passenger that he can spread himself in a voluminous armchair if his head is in the tropics, his feet in the Arctic and his ear drums bursting. The future passenger will not be content with two-dimensional comfort on three-dimensional travel.

Civil Flying in India

WHILE complaints are heard on all sides that the Government in Great Britain will not make up its mind about future policy for civil flying, and that in consequence no plans for the future can be made, the Indian Government has, as mentioned by Mr. Bowyer last week, begun to plan ahead, and the Posts and Air Department has produced a scheme to give India 10,000 miles of civil air routes.

Details of the plan are not yet known. It will be

remembered that when Imperial Airways was pushing ahead towards Australia, it was for a considerable time held up at Karachi. The Indian Government would not grant a subsidy, and insisted that facilities for flying across India would only be given to a company in which the majority of the capital was held in India. Ultimately Indian National Airways was formed, and it co-operated with Imperial Airways and the Government to form Indian Transcontinental Airways, which ran the line from Karachi on to Burma. The Home Government supplied most if not all of the subsidy.

Later on, Tata Airlines began to link Karachi, Bombay, Madras and Ceylon as a private venture, and achieved a very fine record. The statement that the Posts and Air Department has plans for airways totalling 10,000 miles sounds as though the initiative is coming from the Government of India. One of the troubles about India is that too often the Government is obliged to take the lead in social services. The firm of Tata has shown any amount of enterprise, and enterprise is typical of the Parsi community; but Indians as a whole are very apt to wait on a lead from the Government.

Production

REMARKABLE as was the output of aircraft and engines in the twelve months ended March last, disclosed by Sir Stafford Cripps last Saturday, even more remarkable is the fact that the Minister of Aircraft Production was permitted to give those output figures. Hints had been given previously by other Government spokesmen, notably by the Minister of Production, that our aircraft production was rather remarkable, but these hints usually took the form of percentage comparisons, which did not really tell one very much. That Sir Stafford Cripps should have been allowed to give actual figures may be taken as proof that our production is now such that Germany can have no hope of equalling it, and in any case she has had visual (and aural) proof of the operational strength of Britain's and America's air arm lately.

As for the production figures disclosed by Sir Stafford, published on another page of this issue, they tell an amazing tale of progress. It will have come as something of a surprise to many to find that in 1939 we produced less than 8,000 aircraft, or some 660 per month of all types. We on *Flight* are not surprised; we knew that production was lamentably low, and once we were rude enough to say in these columns, in connection with some official percentage-increase figures, that, while these looked very fine, it was a mathematical fact that twice naught is still naught. By the end of 1940 production had nearly doubled, the output being by then 1,250 per month.

From this production to the 2,270 per month of 1943 is a fine step, but it took three years to achieve. This is, of course, explained by the fact that after the Battle of Britain greater emphasis was laid on bomber production, so that the average weight of aircraft was much greater. This was brought out by Sir Stafford, who said that the weight of airframes produced in the last year was 200 million pounds, or nearly 50 times greater than the weight of airframes produced in 1936.

Taking Sir Stafford's figure of 200,000,000 lb. of airframe produced in the last year and dividing by the 27,273 aircraft built, we get an average weight of airframe of 7,333 lb. One-fiftieth of 200 million pounds is 4 million pounds which, divided by the 1,830 aircraft produced in 1936, gives an average airframe weight for that year of only some 2,100 lb. That really is the true measure of the British aircraft industry's achievement.

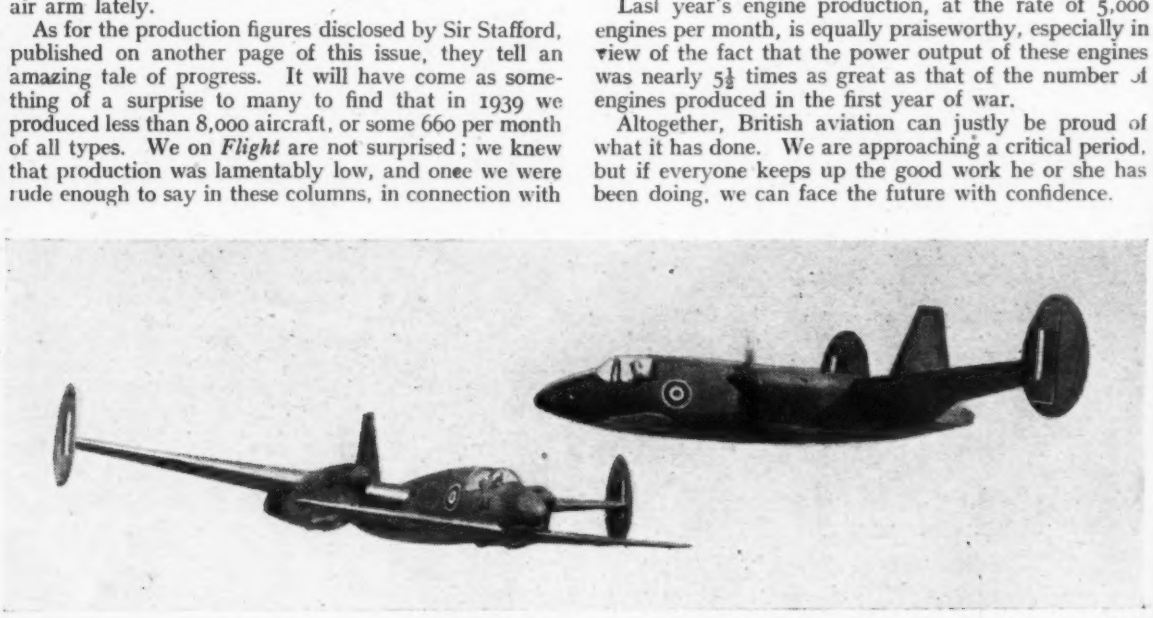
Equally gratifying are the figures for repaired aircraft and for spares production. In the earlier days spares were a thorny problem, and for a time the position was bad. Sir Stafford's 50 to 60 per cent. is reassuring.

Last year's engine production, at the rate of 5,000 engines per month, is equally praiseworthy, especially in view of the fact that the power output of these engines was nearly 5½ times as great as that of the number of engines produced in the first year of war.

Altogether, British aviation can justly be proud of what it has done. We are approaching a critical period, but if everyone keeps up the good work he or she has been doing, we can face the future with confidence.

CONTENTS

The Outlook	599
War in the Air	601
Here and There	604
Britain's Overseas Air Service	606
Behind the Lines	610
Aircraft in Flying Attitudes	610, a and b
Power Plant—Past and Future	611
Anglo-American Aircraft Production	616
Coastal Command's Share	617
Correspondence	620
Service Aviation	621



ON TEST: Two views of the Miles M.39 tandem monoplane, which has been doing a lot of flying lately. Exclusive pictures of this machine were published in our issue of May 4th, and an article on tandems, by its designer, Mr. George Miles, on April 27th. Note the excellent view from the cockpit.

WAR in the AIR

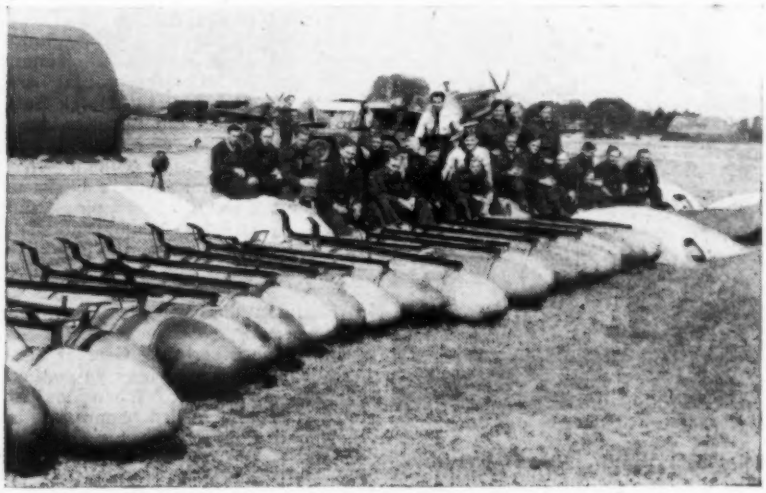
The Modern "Great Twin Brethren" : New Aircraft Weapons in Action : Strategy in the Pacific War

CORAL STRAND : Australian Kittyhawks on the coral surfaced Mornote strip on Los Negros island in the Admiralty group.

DURING the last few days there have been in *The Times* an article and some correspondence about Macaulay's *Lays of Ancient Rome*, and it was stated that the poet's thumbnail sketches of Etruscan and Latin towns were invariably accurate. During the Mediterranean campaign it has been interesting for those familiar with Macaulay to recognise in their modern guise towns which occur in the *Lays*. Taranto is a name which will ever be associated with one of the most glorious exploits of the Fleet Air Arm, and to some with good memories it also recalled the lines: "The dogs of false Tarentum like hunted sheep shall fly." The advance of the Allies into the Alban Hills brought them near the scene of the possibly mythical Battle of Lake Regillus, and when one reads of the fighting round Velletri one remembers that in the rout of the Latins "The horsemen of Nomentum spurred hard out of the fray; the footmen of Velitræ threw shield and spear away."

The modern defenders of Velletri were Germans, not Latins, and though the aircraft of the M.A.A.F. did their best to play the part of the Great Twin Brethren by bringing help from above, they did not have the instantaneously demoralising effect on the foe which was produced when the two strange horsemen came to the help of one of the earliest of Roman Dictators. They played a gallant and useful part, none the less, and the havoc they created among the German vehicles which had been forced down on to the roads in daylight was terrific. So great a proportion of the enemy's supplies was prevented from reaching the front line that one wonders how the Germans managed to hold their positions for so long. One can understand that fanatically brave troops will sometimes resist without food and without sleep, but they cannot hold out without ammunition. This essential the German troops contrived somehow or other to get, and the battle resolved itself into a grim struggle between two skilful Generals and two very brave and determined armies. The *Luftwaffe* played hardly any part in it, although Kesselring is a *Luftwaffe* officer. Perhaps his experiences in Libya had convinced him that it was of little use to rely on the *Luftwaffe* when he was opposed to the R.A.F. and the U.S Army Air Forces.

Last week the pre-invasion bombing of the Continent paid particular attention to bridges over the river Seine, especially between Paris and



FOR DISTANT BATTLES : Fuselage and "airship" long-range fuel tanks on a Spitfire airfield of the 2nd Tactical Air Force.

WAR IN THE AIR

the mouth of the river. That may have been significant, as the German engineers are experts at rapid repairs of bridges, and therefore it is best not to destroy them until little time is left to the enemy.

New Air Weapons

ANOTHER new appearance on the Western Front is described in official communiqués the "*Flak*-busting" Typhoons. They seem to be pretty good at their job, for on one occasion it was mentioned that two of them escorted two squadrons of fighter-bombers, which destroyed an important railway bridge and blasted nearby railway yards.

Other Typhoons now fire rockets. One pilot who has used the new weapon, said: "When a fighter makes an attack and the pilot presses the button to fire his guns and cannon, he feels a terrific vibration throughout the aircraft, and it is said that as much as 30 m.p.h. may be knocked off the speed by the recoils. There is nothing of this sort when rockets are fired—they leave the aircraft smoothly and without a jar, and the pilot wouldn't know they had gone if he didn't see their smoke trail. They travel at terrific speed and strike with tremendous force. Although the pilot hears nothing above the noise of his engine, rockets sound from the ground like express trains. They hit with a terrific impact like a shell, as distinct from the heavy bump with which a bomb lands, and they are the very last word in destructiveness against certain types of target."

BLACK MARKS: Heavy German flak bursts in a formation of 9th U.S.A.A.F. Marauders as the bombing run is made over Dieppe. In the front aircraft the bomb-aimer was killed and the gunner wounded.

The progressive development of fighter aircraft as fighter-bombers is really astonishing. It has recently been disclosed that Thunderbolts and Lightnings now can carry a bomb load of 2,000 lb., one bomb of 1,000 lb. under each wing. What a short time ago it seems when the standard "heavy" bomber of the R.A.F. was the Virginia, which could transport a bomb load of 1,500 lb. That figure was kept secret.

In Burma the airborne troops known as Chindits have been driven off the site which they had occupied across the Japanese line of communications to the south. It was hardly to be expected that they would be left unmolested for an indefinite time, and they knew themselves that superior Japanese forces were approaching them. They still remain a thorn in the Japanese rear, however, and they supported the drive on Myitkyina and the operations in the Mogaung valley by attacking enemy communications. Evidently they are still getting their supplies brought to them by air.

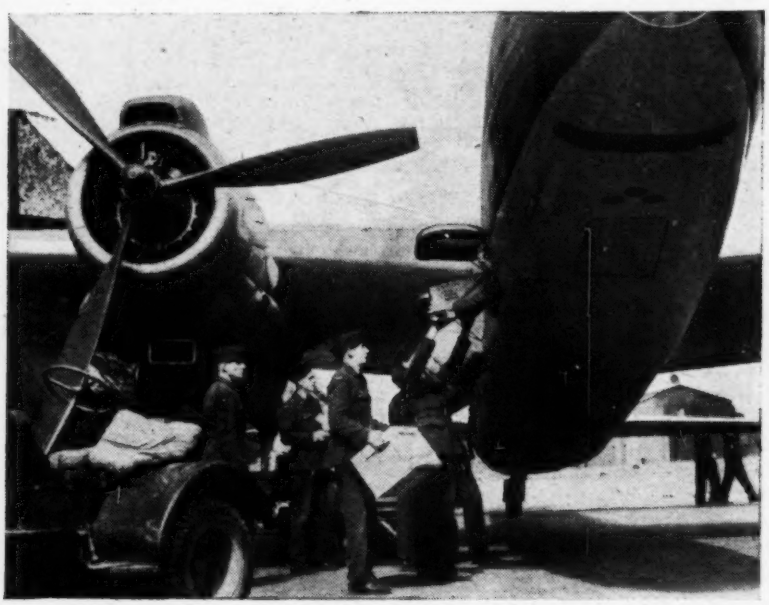
The Pacific War

GENERAL MACARTHUR has said that the capture of Biak Island in the Schouten group to the north of New Guinea marks the strategic end of the New Guinea campaign. Actually there is a peninsula projecting out from the western end of New Guinea, but it is evidently of no military importance.

Now a new stage in the Pacific campaign must begin, and speculations are rife as to what direction it will take. Some believe that MacArthur will strike south-westward to Timor, from which it would still be conceivably possible for the Japanese to strike at the northern coast of Australia—though of late Japanese military policy has been so entirely defensive that the invasion of new territory seems very unlikely. Raids, however, cannot be ruled out. Timor, moreover, would be the natural base for the reconquest of the Dutch East Indies, and Java and Sumatra must be won again, sooner or later.

Others hold the opinion that General MacArthur is more likely to move up towards the Philippines, and thence against the home islands of Nippon, with one eye on the provinces of China which the Japanese have occupied. Nobody is more curious as to his intentions than are the Japanese leaders.

One thing is certain. General MacArthur has developed his own method of using air power. When he first took over the Allied command in the South-East Pacific he defended Australia (his primary task) almost entirely by skilful use of his bombers.



URGENTLY REQUIRED: Loading special freight on to a Vickers Warwick transport.

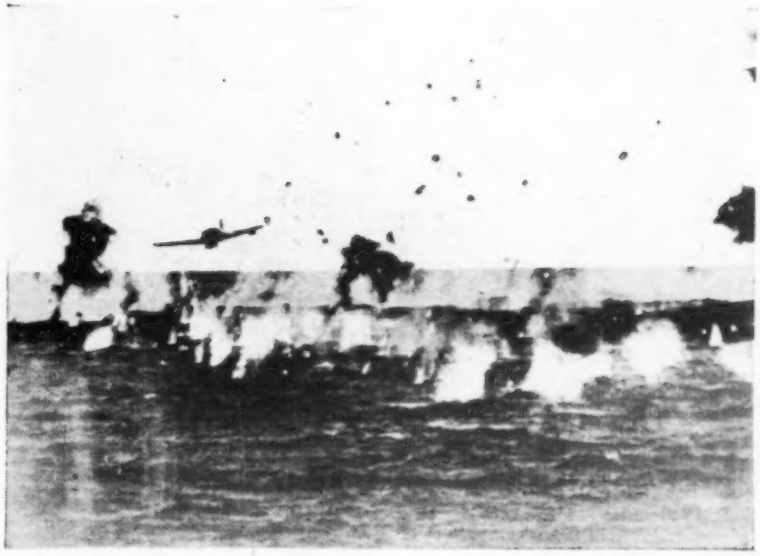
WAR IN THE AIR

As the situation improved sea power was added to air power, and of late combined operations by air, sea and land have been the rule. The American commander has shown originality in the way in which he has by-passed enemy posts of minor importance while he struck at the vital spots. Now his aircraft, greatly increased in numbers, patrol an enormous area of the Pacific, and they combine with naval craft in striking at enemy ships of all categories. As the enemy battle fleet continues to lie *perdu*, the command of the seas has passed almost entirely into Allied hands.

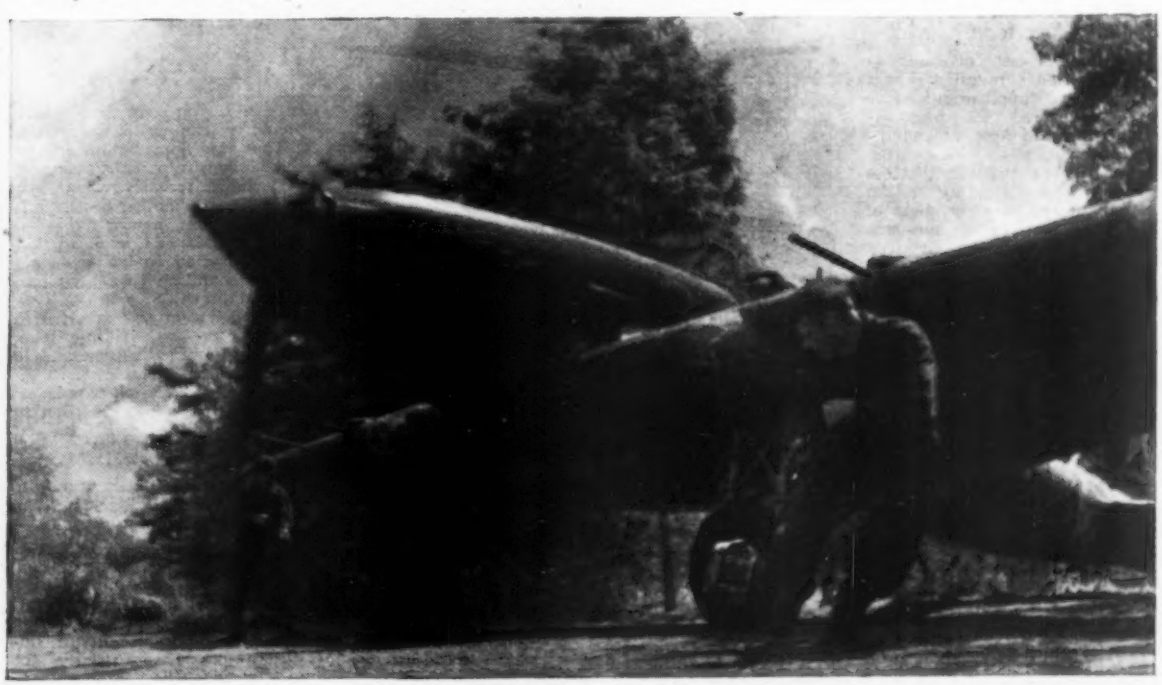
The U.S. Pacific Fleet has worked in well with General MacArthur's plans. Admiral Halsey, who is the commander in the South Pacific (a different Command from the S.W. Pacific) has lately visited New Zealand. He has also shown a great capacity for using sea-air power, and his carriers have done notable work. His tendency has been to strike blows ever nearer and nearer to Japan itself; and it would not be surprising if the plans of the Admiral and the General were found to coincide. The future will show. In the meantime Admiral Somerville in the Indian Ocean has shown that he will not be a passive spectator of these future events, but Burma is likely to provide his main preoccupation when the south-west monsoon is over.

The present week started off extremely well with the occupation of Rome by the Allies, the Fifth Army entering the city on Sunday night. The Germans, of course, announced that they had withdrawn from Rome to save it from becoming involved in military operations, but this was obviously a case of making a virtue of necessity. They fought right back to the very outskirts and, knowing that the Fifth Army would eventually take the city in any event, they sought to buy back a little of their lost credit by withdrawing to the north-west while Kesselring, having previously used Rome's communications just as he pleased, put out the somewhat impertinent proposal that it should now become an open city.

We refrained from serious air attack on German installations in Rome; the *Luftwaffe* no longer has the power to interfere with our occupation of it.



FINAL MOMENT: A second after this picture was taken, the Nikaji'ma 97 Mk. 3 torpedo-bomber seen attacking a U.S. carrier off Truk in the face of concentrated A.A. fire, was shot down by a direct hit.



TACTICAL ATTACKER: A Stormovik low-level attack bomber of the Russian Air Force emerging from its cover close behind the front line. This famous single-seater has a liquid-cooled M-38 engine and top speed of 280 m.p.h.

HERE AND THERE

STAR TURN : The Lockheed Constellation, world's largest transport land plane, on arrival at Washington after flying the 2,308 miles from Burbank, Calif., in 7 hr 3 min., thus setting up a new coast-to-coast record.

Record Month

MAY was a record month for the U.S. Ninth Air Force based in Britain, for they made more than 30,000 individual sorties and dropped more than 20,000 tons of bombs on more than 100 targets in enemy-occupied territory.

Dusky Heroes

LT. COL. BENJAMIN DAVIS, JR., the 31-year-old negro commander of a fighter group in Italy, has been promoted to the rank of Colonel. "The first all-negro fighter group in the history of aviation," adds the Reuter message announcing this from Allied H.Q., "particularly distinguished itself in the operations at Anzio."

Neutral Admiration

HIGH-RANKING Spanish officers expressed great appreciation of the Avro York which they saw for the first time when one of these aircraft flew Sir Samuel Hoare back to Madrid last week.

The officers—Army, Navy and Air Force—were given a demonstration flight of some 20 min. in the York at Barajas civil airport, Madrid.

Latin-American Links

A RECENT issue of *American Aviation* revealed that twenty-three applications have been registered for new air routes to Latin America and the Caribbean area.

The journal added: "High aviation authorities see in the calibre of the new members of the U.S. National Commission of the Permanent American Aeronautical Commission, a sign that the Government is preparing to proceed immediately with the standardisation of aviation laws and procedures in this hemisphere."

U.S. Air Power

FIGURES which showed the U.S.A.A.F. to be "the world's most formidable aerial striking force in point of size and fire power" were quoted at a recent Press conference by Mr. Henry Stimson, U.S. Secretary for War.

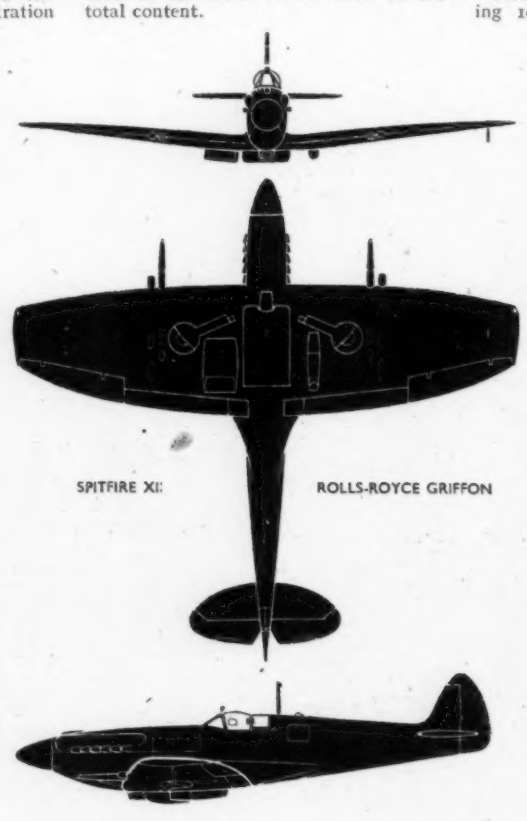
It had, he said, a total strength of approximately 2,357,000, nearly half of whom were already overseas, more than 75,000 aircraft, of which 34,000 were combat types, and 925 bases outside the U.S. and American territories, of which 750 were airfields.

R.C.A.F. Squadrons Overseas

THERE are now forty-two R.C.A.F. squadrons on actual operations outside Canada, and two more are about to go overseas; they include bomber, fighter, reconnaissance, Coastal Command, night fighter and intruder squadrons, and they represent more than half the total number of R.C.A.F. squadrons.

There are, however, ten times as many R.C.A.F. aircrew scattered through the R.A.F. as make up the personnel of the forty-two overseas squadrons, representing some 25 per cent. of all aircrew in the European and Mediterranean areas under British tactical command.

It is expected that the proportion will soon be increased to one-third of the total content.



Municipal Landing Strips

A PLAN to construct 400 municipal landing strips for communities of more than 1,000 population, at a total cost of $20,000,000, was outlined as a post-war employment scheme at the first national conference of the Aeronautical Institute of Canada held recently at Toronto.

These landing strips would serve for feeder lines as well as private flying, and would give employment to many now in the R.C.A.F. The Institute was formed about two years ago to promote aviation in Canada and to see that returning Air Force personnel have a chance to operate feeder-lines.

Nearly 300 men and women representing 100 municipalities and eight provinces as well as commercial and Service interests attended the meeting.

Maternal Appreciation

IT is nothing unusual for an ex-A.T.C. cadet, on joining the R.A.F. or F.A.A., to write and express his appreciation of the pre-entry training he received.

That this appreciation can be shared by the parents of cadets was shown recently when Mrs. S. E. Barton, mother of Flt. Sgt. E. A. Barton, now a flying instructor in Canada, made a handsome donation to her son's old A.T.C. squadron (No. 1413 Ealing Squadron).

The donation was invested in a mace for the squadron band which was formally presented to them by Mrs. Barton at last Sunday morning's church parade.

Flt. Sgt. Barton had risen to the same rank in the A.T.C., and came through his I.T.W. second out of 500.

In a recent letter home he wrote, "Thank goodness for the A.T.C."

Faster and Cheaper

ACCORDING to an imposing array of figures just issued by the U.S. War Production Board, America's aircraft industry has been turning out aircraft at the rate of one every five minutes, reckoning 24 hr. a day and six working days a week, during the first four

TRANSPORT

A BACKGROUND OF UNPARALLELED EXPERIENCE

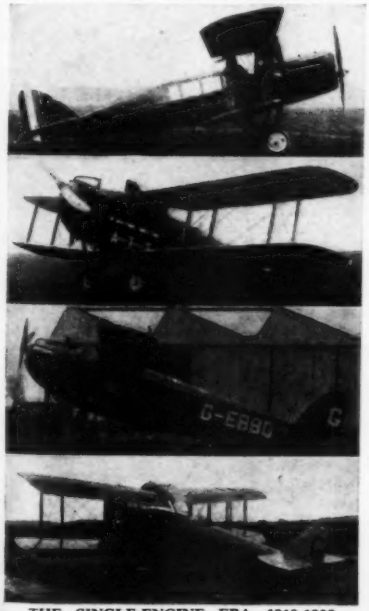
THE FIRST INTERNATIONAL—1919:
The D.H.4a flew the first public London-Paris Service.

Before the end of the first great war de Havilland aeroplanes were being used in substantial numbers for transport. Communication squadrons of the Royal Air Force maintained services between Britain and the Continent which expanded after the armistice into an ambitious airline network carrying important passengers and official mails between London, allied capitals in Europe and the Army of Occupation.

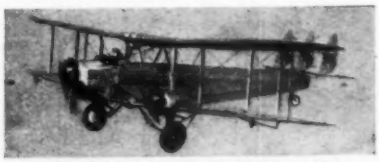
May 1st, 1919,—a notable date—saw the dawn of internal civil flying and was marked by a series of flights by de Havilland to focus attention on projected lines. By August 25, 1919, interim agreement between the Powers had been reached and the world's first international air route was opened by D.H.4a.s and D.H.16s operated by Aircraft Transport and Travel Ltd., flying between London and Paris.

The Amsterdam, Brussels and Cologne lines soon followed and on all these services the D.H.18, the first aircraft which was not frankly a converted bomber, was employed. When Daimler Airways entered the air transport field in 1922 their schedules were based on the performance of the D.H.34—eight passengers, two pilots and a cabin boy—and their fleet maintained the fastest and most popular service on the Paris route for several years until Imperial Airways absorbed and continued to operate all the lines under one control.

Charged with responsibility of forging the links in the Empire air chain, the national combine entrusted the de Havilland Company with the design and construction of a fleet of liners for the Cairo–India stage.



THE SINGLE-ENGINE ERA—1919-1925:
The D.H.16, development of the D.H.9a; the D.H.18, the first designed-for-commerce type; the D.H.34 on which the early continental services were firmly established and the D.H.50 on which many airway systems were built, notably in Australia.



THE MULTI-ENGINE FORMULA—1926:
The D.H.66, three Jupiters — flew on any two.

The result was the Hercules (D.H.66) first to the new reliability formula—"Three engines—fly on any two."

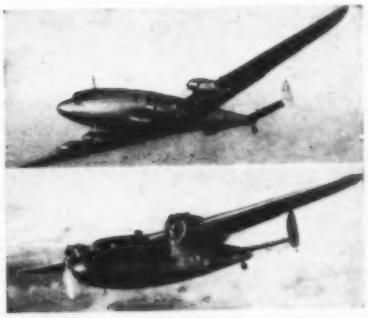
No. 1 of the type left Croydon on Boxing Day, 1926, to fly to India with Sir Samuel Hoare, then Secretary of State for Air, as passenger accompanied by Lady Hoare and an official staff. For five years these robust aircraft maintained the vital Cairo–Karachi service across sea and desert with regularity and with a fine maintenance record.

Meanwhile in Australia air transport, chiefly using converted wartime D.H.9s at first, expanded rapidly as the D.H.50—pilot and 4 passengers, 100 m.p.h. cruising on the 240 h.p. Puma engine—became available. It has been said with truth that the D.H.50 made Australia's great airways system possible. The same type was employed extensively in Africa and for many pioneer flights to India, Australia and the Cape, for long-distance "taxi," newspaper and ferry services in the British Isles.

The twin-Gipsy Dragon marked, in 1932–33, a new era in the economics of air transport when the late Edward Hillman purchased a fleet to establish internal lines and an unsubsidised London–Paris service in competition with and at lower fares than the subsidised lines. His lead was followed by other operators in Great Britain, such as Jersey Airways Ltd., then by many others all over the world.

It was early in 1934 that the de Havilland four-engined Express Air Liner (D.H.86) was first tested and a fleet was shortly flown to Australia to equip and establish the Singapore–Sydney link in the Empire route

THE ADVENT OF THE GIPSY.
The Dragon, two Gipsy Majors, gave unprecedented payability; the D.H.86, four Gipsy Sixes, equipped British and Empire services; the Dragon Rapide, two Gipsy Sixes, still the essence of practical and economical feeder-line operation to-day.



CRUISING SPEED LEAPS UP—1938-1939:
The Albatross, London to Paris in an hour; the Flamingo, medium capacity and high performance.

run by Qantas Empire Airways. As in the Dragon the keynote of the D.H.86 was "payability" and it was quickly adopted by Imperial Airways, Jersey Airways, Railway Air Services and a large number of other transport companies. Many of these craft were impressed at the outbreak of war and are still used for communications. The development of the 200 h.p. Gipsy Six Engine for the D.H.86 made a new power unit available for the Dragon and resulted in the D.H.89 or Dragon Rapide, of higher performance, which is to-day used in large numbers on short-haul and feeder air lines all over the world and, known as the Dominie, is a standard Royal Air Force type.

In 1938 the Albatross, widely known as the cleanest aircraft ever built, was launched. A fleet supplied to Imperial Airways and put into operation on the London–Paris route reduced the airport-to-airport time to within the hour. The sphere of operations of the Albatross was rapidly extended so that when war was declared these aircraft were able to maintain high-speed communications with Africa, Iceland and elsewhere.

The Albatross was followed by the Flamingo twin-engined all-metal transport of medium capacity and high performance. In September, 1939, orders were in hand for many of these aircraft from many of the world's leading air-transport operators.

Production continued for war-transport purposes until the entire capacity of the de Havilland world organisation was turned over to building the Mosquito, fastest and most versatile of all war types.

Even that outstanding de Havilland aircraft, produced first as a bomber, adapted for reconnaissance duties, developed as a day and night fighter and now employed on many other duties, has a civil version which is used daily on the most hazardous of regular services—those which cross territories occupied by the enemy.

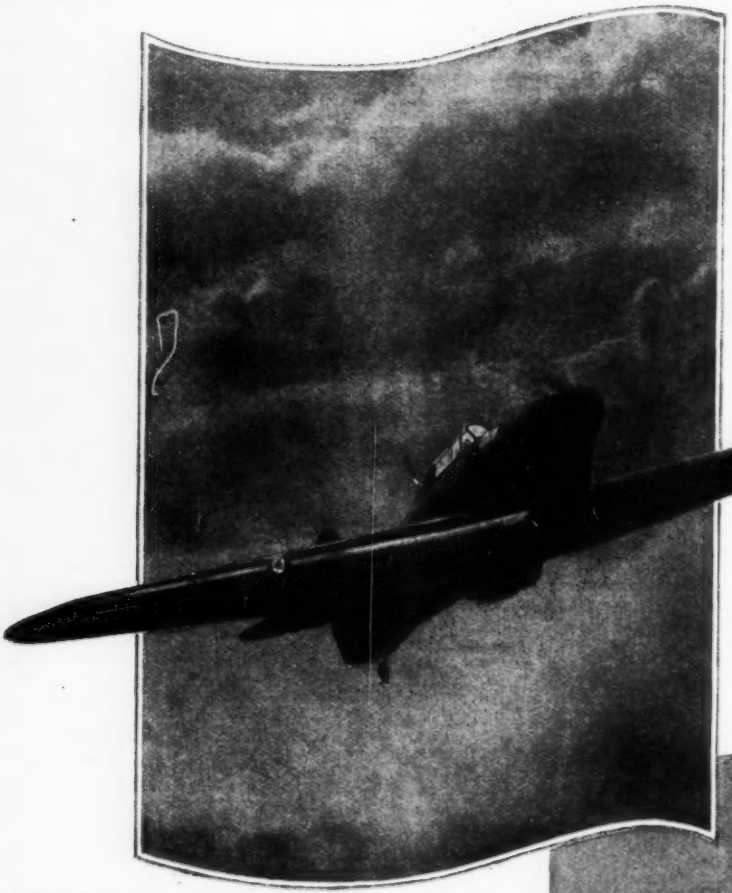
With a background of unparalleled experience during the evolution of air transport, a remarkable record of technical progress in war time and an unquenchable enthusiasm for aviation in the service of civilisation the de Havilland world enterprise will be ready, when the time comes, to turn its full resources to the needs of reconstruction.

THE WORLD'S FASTEST—1944:
The Mosquito, most versatile aircraft now in production, has a civil version whose speed enables it to keep routes open under the nose of the enemy. It carries mails, freight, and important passengers faster than any other vehicle in the world.

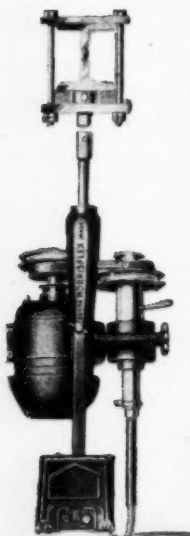
DE HAVILLAND

In the attack to-day — on the trade routes of the future

Fitness for Purpose



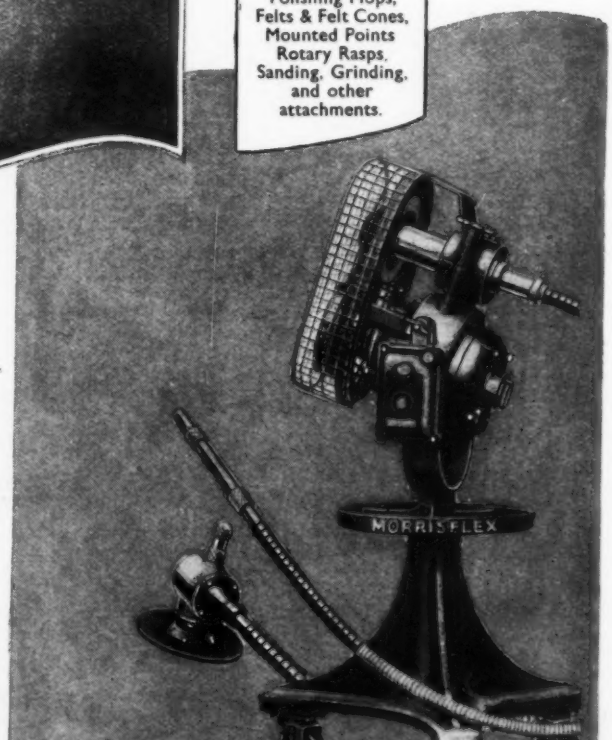
REX
Rotary Files and Cutters.
MORREX
Wire Brushes.
MORRISFLEX
Polishing Mops, Felts & Felt Cones, Mounted Points Rotary Rasps, Sanding, Grinding, and other attachments.



Fitness for Purpose. The right machines for the job — the right tools.
MORRISFLEX FLEXIBLE SHAFT EQUIPMENT is specially designed to ensure speed with accuracy and high finish —to save valuable material and man-hours, and reduce production costs.
MORRISFLEX Equipment is playing a prominent part in the war effort because its uses are many and varied throughout all branches of the Aircraft Industry.

Write for Catalogue.

B. O. MORRIS LTD.
SHIRLEY, BIRMINGHAM
Shirley 1237
Grams: 'Morrisflex, Birmingham.'



Morrisflex

Flexible Shaft Equipment

HERE AND THERE

months of 1944. Total output for the year will be 100,000 aircraft costing about £5,325,000,000.

Mass production has brought about a big reduction in the cost per aircraft; in the case of the heavy bomber it has been halved—from $500,000 down to $250,000 since 1942—while the cost of a fighter has been reduced from $70,000 to $50,000 during the same period.

Polish W.A.A.F.'s

SIX hundred Polish women have travelled together from Africa and the Middle East to join the W.A.A.F. in Britain. At present they are undergoing training and will eventually be posted to Polish squadrons as cooks, telephonists, wireless operators, teleprinter operators, clerks, flight mechanics and equipment assistants.

U.S. Rocket Jobs

FIVE types of U.S.A.A.F. fighter have been equipped to fire rockets and have been used successfully against the Japanese in the Pacific and the China-Burma-India theatres of war, Washington announced recently.

They are the Warhawk, Thunderbolt, Lightning, Mustang and Airacobra.

Fighters in Retirement

A NUMBER of U.S. fighter aircraft are now being used by the American Training Command as advance trainers. Most of these are Warhawks, the others being Lightnings, Thunderbolts and Mustangs. Some of the Lightnings have had their radio removed to make room for an instructor's seat.

U.S. Fighter Bomb-loads

IT was officially disclosed last week that U.S. Thunderbolts and Lightnings are now carrying a 1,000 lb. bomb under each wing—double their previous load—and that a combination of low-level and dive-bombing is being successfully employed. One flight dive-bombs the *flak* batteries, while another goes in at low-level to bomb the primary objective.

Society of Arts Medal

THE Albert Gold Medal, highest award of the Royal Society of Arts, is being conferred this year upon Sir Henry Tizard, K.C.B., D.C.L., F.R.S., president of Magdalen College, Oxford, for his invaluable services in the development of aircraft.

By general consent of those who know the facts, much of the credit for our outstanding successes in the air is due to him.

Australian Beaufighter

THE first Australian-built Beaufighter was handed over to the R.A.A.F. last week by the Aircraft Production Department at Melbourne, 14 months after the necessary details for manufacture had been received from Britain.

Like the Beaufort, the Australian-built Beaufighter embodies a number of special "mods" to suit operating conditions in the Pacific; long range, for example, is an important factor.

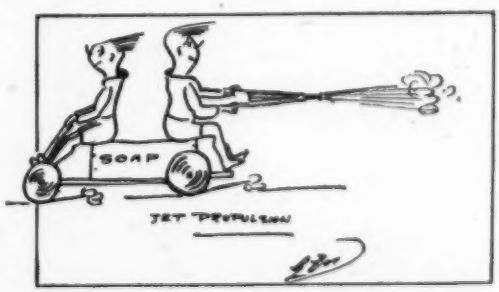
Senator Donald Cameron, Australia's Minister for Aircraft Production, described the production of the first native built "Beau" as being the culmination of the most intense industrial effort in Australian history.

HOLE IN ONE: A Kellett YO-60 autogiro (300 h.p. Jacobs engine) of the U.S.A.A.F. Materials Command drops easily into a clearing among high trees. A number of these aircraft have been supplied for Service test with a transparent panel in the floor of the cockpit for direct downward vision.

Delivery of Goods

SOME idea of the prodigious amount of work done by the U.S. Air Transport Command was given recently by its Chief of Staff, Brig. Gen. R. E. Newland. Here are some of the astronomical figures he quoted: During April its ferry pilots flew 29,000,000 miles to deliver bombers to Europe and the Pacific. During March its transport pilots flew nearly 20,000,000 miles, carrying 60,000 war-important passengers and many thousands of tons of vital cargo to battlefronts. During 1943 its aircrews spent more than 2,100,000 hours in the air, flying over 880,000,000 passenger-miles and 425,000,000 ton-miles.

The Command was formed in May, 1941, with two officers, four other ranks, and one civilian clerk; to-day it has a military strength of 108,000 and a civilian personnel of 20,000.



Missed 'Im!

PUNCTUALITY is universally accepted as a virtue; and virtue, we are told, is its own reward. But according to a recent issue of *La Suisse*, Rommel's reward for punctuality would have been death had he arrived to time at a certain German headquarters in a French castle recently.

He was due at 9.30 a.m., but was a few minutes' late. "This saved his life," said the newspaper, "for the castle was bombed and completely destroyed at 9.30 precisely."

A pity!—if we may say so across the havoc of war!!

More Bother at Brewsters

CANCELLATION of the U.S. Navy's contract with the Brewster Aeronautical Corporation for fighter aircraft brought about a "stay-in" strike by 8,000 of their employees. As a protest against the termination of their employment (the cancellation operates as from July 1st) the men and women in two of the firm's plants refused to leave the premises day or night, and food was sent in to them by relatives and friends.

President Roosevelt then asked Government agencies if further contracts could be placed, as a result of which it was arranged to continue the production of aircraft parts at the corporation's Long Island plant. The strike was called off as soon as the workers learnt the facts.

D

Britain's Overseas Air

Design for Maintenance in Extremes of Weather : Features of Ideal

THROUGHOUT my tour of Royal Air Force Transport Command and British Airways routes—which carried me some 26,000 miles over four continents—I found a general impression among aircraft operators and maintenance engineers that British designers and constructors were less ready than their American contemporaries to design for regional climatic and operational conditions.

The view is unpalatable, and I do not think it is true. Circumstances have conspired strongly against the British industry in its development of transport aircraft. Before the war the existence of a single "chosen instrument" restricted technical development of the larger and more costly British transport to narrow lines. Not a single metal aircraft built to an Imperial Airways specification was ever sold to another operator. In fact, some of the company's contracts for aircraft contained a clause specifically forbidding such sales.

How different has been the experience of the American manufacturer! With nearly a score of vigorous, independent airline companies operating inside the borders of a vast country, the urge for improvement of the breed was sharp and continuous. One constructor emerged head and shoulders above the rest. Douglas twin-engined transports flooded the airways—not only of the United States but of the world. To-day DC-3 aircraft, mostly in the *Dakota* (C-47) militarised form, make up the largest group of any single type of transport aircraft in service.

U.S. Favoured by Conditions

Such wide and varied use of American aircraft, stimulated by the competitive domestic airline system, has provided the American engineer with an immense fund of operational knowledge. The British aircraft engineer must make do on much less. Every condition governing airline operation has favoured the American in comparison with the Briton. Exhaustive and detailed operational data are published regularly in the United States which show the latest available results achieved by airline companies; in England similar operational information was consistently refused the aircraft constructor, although it was understood when Imperial Airways was formed that such information would be made available to the industry.

Undoubtedly in the past few years the technical staff of Imperial Airways and now of British Overseas Airways has established most helpful liaison with the industry. It may be that the constructor has not always shown himself immediately receptive to the suggestions made by our airline technicians, no matter how well based on the lessons of actual experience. The fact remains that the British system, lacking the elements of competition and independent private enterprise in airline operation, and perpetuating an atmosphere of secrecy about operational results, does not lend itself freely to the widespread dissemination of knowledge. It is relevant to recall that the historian Gibbon, when writing of monopolists, said: "The new improvements so easily grasped by the competition of freedom are admitted with slow and sullen reluctance in these proud corporations, above the fear of a rival and below the confession of an error."

Extenuating circumstances may condone or explain a crime; they do not expunge it from the charge-book, and the British engineer would do well to ponder the impression of his elasticity and receptiveness of mind which prevails overseas, whether he agrees that it is justified or not. In the equable climate of the British Isles, full appreciation of weather conditions in less placid regions is certainly difficult. It is not easy to imagine, in the moderate home temperatures and humidities, 130 deg. in the shade at midday—not uncommon in the Persian Gulf; 60 deg. below zero—in Canada; humidity 95 per cent., as in parts of India and West Africa. Nor is it easier to appreciate the enormous swing of temperature and humidity from season to season, or over a distance of a few hundred miles.

Climatic Effects on Construction

I heard in Accra what happened to an excellent and well-tried monoplane of normal wood construction which, after some months of flying in the excessively humid coastal belt, was sent up to Kano, some 500 miles inland. The average difference in humidity between Lagos and Kano is no less than 65; and in the drier air the plywood seams, which had had a thorough soaking on the coast, opened as much as three-quarters of an inch, the effect being especially noticeable under the main planes by the inspection ports. The glue had virtually disintegrated in the coastal humidity, and subsequent contraction in the drier air had had the inevitable result.

Not even latitude is a sure guide. Dependent on the distance from the sea and the local terrain, which may be steaming jungle or arid desert, areas on the same latitude may vary enormously. On one journey from Cairo to Lagos the traveller passes through four or five distinct kinds of climate, ranging from the dry and healthful conditions of Northern Nigeria and much of the Anglo-Egyptian Sudan, to the damp heat and mosquitoes of Lagos.

The aeronautical engineer of any nation has one remedy for lack of personal knowledge of local conditions. He can travel and see them for himself. The American has

Engine maintenance on a Short Sunderland in the steaming heat of West Africa.

Air Services

...s of "...deal" Overseas Air Liner

By EDWARD C. BOWYER

IN this article Mr. Bowyer discusses some of the features of aircraft design and equipment which need careful watching if the machine is to give complete satisfaction to the user. He mentions the view expressed, although he does not subscribe to it, that British manufacturers are less ready than some others to design for the special requirements of the user. He puts in a strong plea for sending representatives over the various air routes to study conditions on the spot.

Although he is head of the information department of the S.B.A.C., Mr. Bowyer is here expressing his own views and is not speaking for the Society.

not quite the same spur to move outside his own country; he has available plenty of domestic experience of continental weather. The Englishman, on the other hand, must travel far and wide to learn his lesson. In my view, few better services could be rendered the British aircraft industry by the Government than the utmost help in facilitating visits by British designers and engineers to the main operating centres abroad. It will obviously be difficult for such key men to leave their factories while the war remains at its peak, but as soon as possible British technicians should be sent out in swarms. They will learn more in a few hours of discussion with the men on the spot than in months of study of reports and memoranda. *The mind is not sufficiently receptive to the problems of great heat when the thermometer outside the drawing office window stands at 60 to 70 deg. Fahrenheit.*

Consideration of climatic effects starts logically with structural materials. Metal is least impervious to climatic changes, though it must be watched where salt air and salt water are found, and may behave peculiarly in extreme cold. Ordinary wood rots badly and is destroyed by such widespread pests as white ants. Reinforced and the modern "improved" woods, bonded with plastic resins, generally stand up well to heat and humidity. Experiments at Indian wood research laboratories have proved several such woods to be satisfactory, and actual flying experience, though limited, supports the laboratory results. More flying experience is desirable.

Rubber Components

Rubber deteriorates much more rapidly in the tropics than in temperate zones, and should be avoided wherever possible. Rubber de-icers rot quickly, though the process may be decelerated if the de-icers are well coated with graphite grease lubricant and are slightly slackened off, which delays splitting of the rubber. (The reader may rejoin that de-icers are scarcely necessary in the tropics; the answer is that aircraft may travel great distances, or be transferred at brief notice from the tropics to a region where de-icers become immediately necessary.) Where circumstances permit, of course, the de-icers are removed.

Tyres must be protected at all times from strong sunlight, and it is common practice to cover them, when the aircraft is standing on the ground, with a piece of fabric or canvas which has been coated with aluminium dope. Wheel brakes tend to run very hot; they have been known to cause burst tyres and major damage. Hence, particular attention to cooling the brakes is indicated.

Apertures and Safety

Rubber connections, especially in oil systems, need most careful watching. Petrol-resistant hose, I was informed, gives satisfaction if kept under strict inspection.

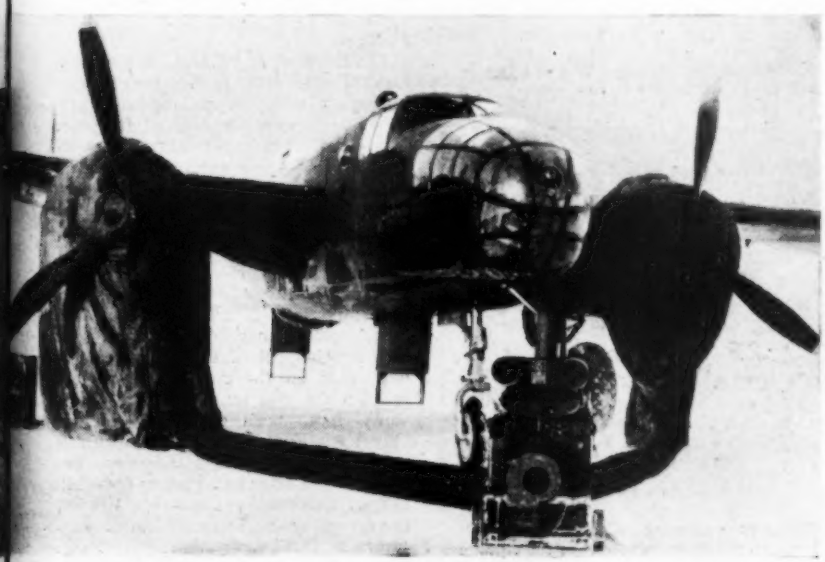
Fabric rots quickly, though the process may be greatly delayed by rubbing down till an almost metallic surface is produced, which has the further advantage that it eliminates "panting" of the control surfaces.

Transparent plastics are generally good but tend to contract seriously in strong sunlight, dragging the panels from the retaining strips and causing buckling. Some transparent plastics will discolour, obscuring vision and involving risk to aircraft and crew. Much of the trouble actually experienced, however, it not directly attributable to the material employed, but is due to scratching and lack of adequate cleaning.

"Avoid Apertures." Those words might well be inscribed in giant letters on the walls of every drawing office where the design of an overseas transport is in hand. Apertures of all kinds and in all places are possible sources of trouble for the maintenance engineer. They may seriously affect the safety of the aircraft and the comfort of the passenger.

Certainty that openings in the structure will not cause difficulty can be assured in tropical countries only by covering them up when the aircraft is standing on the ground. Otherwise, grit, dust and sand will find a way inside—and their penetrative powers must be experienced to be believed. Another user of apertures is the insect. Such energetic little beasts as the Indian builder beetle will construct a home in a few hours inside the tiniest aperture which is left uncovered. Even the local vegetation is a possible danger; at some seasons of the year in India, orifices such as the pitot head will become blocked with drifting flower petals.

The abrasive effects of dust and sand in a mechanical system are astonishing. In the Middle East maintenance engineers have had to make thousands of bushes for cooling gills; the sand of the desert destroys them in a few hours. Red laterite dust in West Africa, which plays such havoc with one's shoes, will damage an engine almost as thoroughly as the applica-

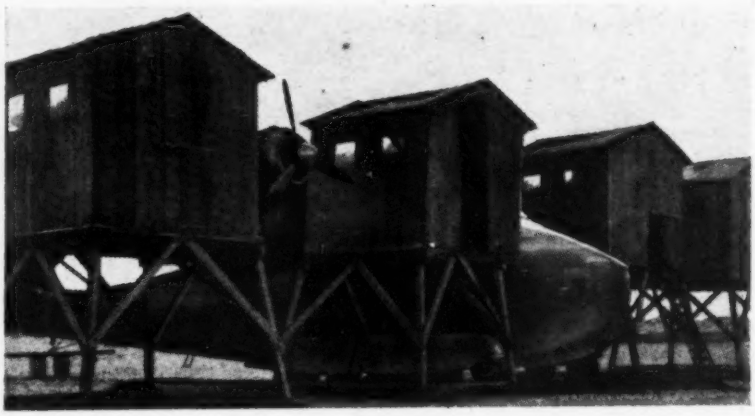


Keeping the engines of a Mitchell from freezing solid in the intense cold of Alaska.

BRITAIN'S OVERSEAS AIR SERVICES

tion of a diamond cutting paste. Hence, the aircraft and engine designer will be well advised to keep apertures to the absolute minimum. Vents and breathers will be necessary; at the least those which are essential should be located for easy protection when the aircraft is standing.

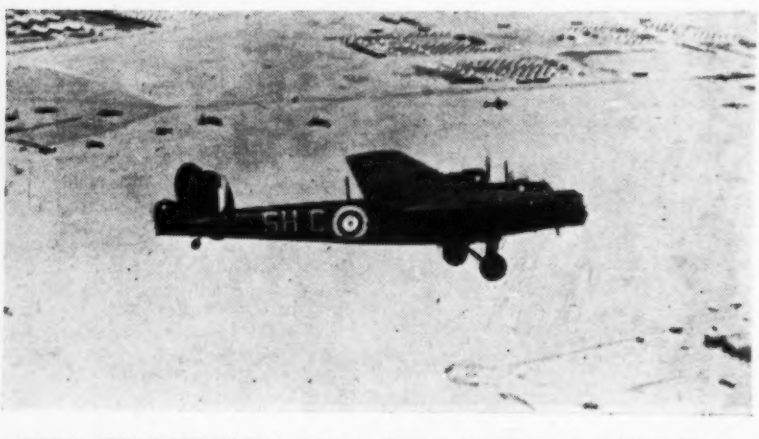
Humidity means a risk of corrosion. Components and items of equipment which are destined for tropical use must be sent out in adequate packings. Ball races and similar delicate parts have been found on arrival in India to be rusty under air bubbles in the grease with which they have been covered. I heard of new engines which were so badly corroded when they were received at tropical depots that every engine had to be stripped, and every cylinder lapped and honed. Indeed, engine erection and maintenance should be done in air-conditioned workshops. Even engines which were packed for travel in cellophane envelopes sometimes arrive at the danger-point of corrosion, as indicated by the colour of the anti-moisture bags packed inside the envelope, usually because a minute tear has developed in the wrapping during the journey.



WEATHER PROBLEM IN RUSSIA : Small wooden huts on stilts protecting the engines of a German Me 323 on the north Russian front. The engines are too close to each other to enclose them all.

In West Africa, humidity over part of the year is so heavy that engine covers cannot be used for protection while standing, because moisture would get trapped inside them, and serious condensation might result. Frequently as much as half a pint of water is drawn off from the drain cock of a main fuel tank after a night in the open.

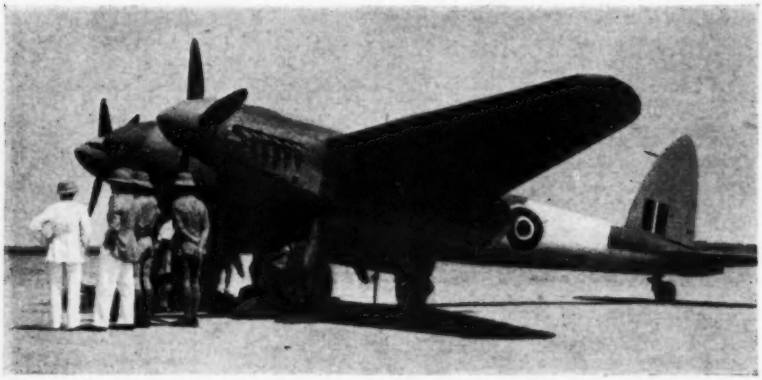
Inevitably, high humidity causes much trouble with radio and other electrical equipment. Leads, joints and conduits must be protected by non-conducting flex. Approval was expressed to me of the system which fixes leads in a cement, with jury leads for replacements, thereby totally excluding moisture. Serious condensation will occur even with magnetos and instruments in store; package in hermetically sealed boxes is one adequate solution.



METAL, HEAT AND SAND : A Bristol Bombay flying over the Western Desert where an aircraft can go from intense heat to cold in a few minutes.

The contrasting extreme of temperature in the British Empire is met with most strikingly in Canada. Sixty, seventy or more degrees of frost are associated with engine starting problems and to some extent with eccentric behaviour of materials. Nearer the freezing point, icing-up of control surfaces and of the engine induction system become major causes of inefficiency and danger.

"Winterisation" of aircraft is still the subject of detailed work in the U.S.A. and Canada. Prolonged tests on every aspect of operation, and in particular on the congelation of oils and on oil dilution in winter conditions, have been conducted by the Royal Air Force and the Royal Canadian Air Force at Kapuskasing, and by United States technicians at White Horse, Fairbanks, Alaska. Engines have been tested in many hundreds of hours of test-bench running and controlled flying.



WOOD, HEAT AND MOISTURE : Mosquitoes are operating on the Burma front, and considerable knowledge should thus be acquired as to the effect of the climate on resin bonded plywood.

BRITAIN'S OVERSEAS AIR SERVICES

De-icing is naturally a predominant interest of Canadian and transatlantic operators. American experiments in application of heat for the de-icing of leading-edges are being watched in Canada with much interest, but at present with a large admixture of scepticism. I gained the clear impression that the work on this subject has a long way to go before worthwhile results will be obtained. In the meantime, rubber de-icers are most generally in use.

Carburettor de-icing was described to me as vital. The engineers of one prominent operating company are working on both heat and alcohol injection systems; until one or the other is perfected, this company may specify the inclusion of both. Oil systems tend to run very cold, causing serious trouble over oil dilution. In some aircraft, designed and built in kindlier climates, the oil cooler has no cover, with the result that the oil never reaches the temperature where cooling is necessary. Hydraulic recording instruments must be "winterised" by putting anti-icing fluids in the system. And even anti-icing fluids will freeze if the temperature falls enough—as it usually does in Canada some time or other during the winter months.

Excrescences are classed with apertures as undesirable for flight in wintry conditions. Exposed controls on elevators and other moving surfaces always ice up badly. External mass balances catch ice with alarming rapidity. Every detail possible should be packed inside wings or fuselage.

The briefest journey overseas will emphasise the fundamental importance of adequate and efficient ventilation. During my own journey I flew for hours at a time in a temperature considerably below freezing point, and for other hours when a thermometer inside the cabin would have recorded more than 100 deg. Once or twice the humidity was most trying, reducing the passenger to an oozing mass of near-humanity and one's clothes to sodden shapelessness.

Problems of Ventilation

Ventilation must, of course, be available at all times—on the ground and in the air. An aircraft standing in the open in tropical sunshine will soon become an oven, unless the air is kept in continual movement by electric fans. In bitter contrast, pin-point apertures and ill-fitting doors will transform a contented passenger to a discontented icicle in an hour or two when flying high in wintry weather. It is also of little use to provide ventilators and heaters which raise the temperature of the upper air in the cabin nearly to roasting point and leave the lower air—where the human cargo is reclining—the home of a really smart frost. On my way back across the North Atlantic, where for some time we flew at more than 20,000ft., the air in the upper half of the *Liberator* was warm enough to broil an egg, but down below, where the passengers reclined on their mattresses and breathed heavily through their oxygen masks, any condensation from the mask froze thickly and instantly on one's chest.

I have spoken earlier in these articles of the poor shape in which I reached Nassau after a journey of 6,500 miles from Accra in 38½ elapsed hours. My condition on arrival was directly attributable to a searching and inescapable draught which chilled me to a point where sleep was impossible.

In India, at midday, we became conscious of great heat, and discovered on investigation that engine heat was pouring into the cabin through a duct which had been opened by a careless movement of the arm by one passenger, who was quite ignorant of what he had done. It was closed at the expense of three burnt hands and several burnt fingers; a metal cover and metal hasp when nearly red-hot are singularly allergic to human flesh.

The Need for Pressure Cabins

Clearly, in wartime the traveller must expect—and he gets—austerity travel. The machines in which he flies may have been hurriedly fitted with improvised ventilation and heating, if fitted at all. That can be accepted—for the time being. But it is clear that the post-war traveller will demand, and must receive, the most efficient forms of ventilation that can be devised. A transport aircraft which is excellent in every other way may fail because of a poor ventilating system.

One obvious path of advance lies with the adoption of pressurised cabins, which, incidentally, many experts whom I consulted favour for all long-haul passenger flying. Pressurisation raises immediate possibilities of complete air conditioning, which is the only method of eliminating the greater part of discomfort due to climate. I am convinced that the importance of this aspect of transcontinental and transocean air transport cannot be overstated.

Space forbids more than a brief survey of the numerous points which need close consideration by the designer—not only of the aircraft and power plant, but of the majority of component parts and equipment. Probably, fault could be found with the detail design of most units, in the make-up of even a modern airliner, if the examiner were the maintenance engineer of a company operating aircraft in extremes of climate and over difficult country.

Personal experience affords the means whereby design can be directed into the correct channels. To meet the demands of post-war air transport, British designers must be more than ever ready to go abroad and see for themselves.

(Another article will be published next week)

DEATH OF COL. OUTRAM

WITH the passing last week of Lt.-Col. H. W. S. Outram, not only the A.I.D., but the British aviation world as a whole has lost one of its outstanding figures. It is not too much to say that British aircraft owes much of its excellence to him, for the rigid inspection imposed on every piece, from the raw material to the finished stage, ensured that, so far as was humanly possible, there should be no faulty component or assembly. There have been times when the inspection has been considered too rigid and rejections unnecessary, but that is a fault in the right direction, and as a result structural failures have been remarkably few.

Not the smallest of Col. Outram's difficulties was that of maintaining the high standards set in the early days. When the expansion came it caused as great scarcity of skilled men in the Aeronautical Inspection Directorate as in other branches of the industry, but on the whole it can be said that Col. Outram succeeded in finding and training the necessary personnel.

In the early days there used to be a sort of friendly enmity between the firms and the A.I.D., and Col. Outram himself was fond of saying that the initial letters of his department stood for "Always In Doubt." Actually the industry and the A.I.D. got on well together and friction was never very serious.

After being seconded from the Royal Engineers to Farnborough in 1915, Outram was transferred to inspection, became chief inspector and, in 1923, Director of the A.I.D. He became Director of Aircraft Production in 1938, Deputy Director-General of A.I.D. in 1941, and Director-General last year. The aircraft industry will miss him

Behind the Lines

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Gnome-Rhône

A SINGLE-STAGE three-speed supercharger is being developed by the Gnome-Rhône company. The supercharger is intended for the Gnome-Rhône 18R eighteen-cylinder twin-row radial of 2,200 h.p. for take-off, a type which is not yet in production.

A Zeppelin Design

A FRENCH company is reported to be engaged on the production of the ZSO-523, a cargo aircraft designed by the German *Zeppelin Luftschiffbau G.M.B.H.*, of Friedrichshafen.

Powered with six Gnome-Rhône 14-N engines of about 1,000 h.p. each and equipped with a landing gear consisting of six partly retractable wheels, the aircraft is said to have a gross weight of 90 tons.

Rumanian Gliding

DURING the flying season of 1943 the two gliding schools operated by the A.R.P.A. (Rumanian Association for Propaganda and Aviation) at Budesti-Chioplea and at Campina have trained and issued licences to 191 glider pilots. 178 of them qualified for the "B" licence, eleven for "C" and two received instructors' tickets.

The schools employ twenty-two gliders, among them the German Grunau 9, Schulgleiter, Grunau Baby and two Polish types, Wrona and Salamandra.

The A.R.P.A. also maintains repair workshops at Budesti-Chioplea.

Morale-boosters

HAUNTED by the possibility of a repetition of 1918, the German High Command has, for the first time, officially appointed political commissars in all branches of the armed forces.

Bearing the title N.S.F.O. (*Nationalsozialistischer Fuehrungsoffizier*—Nazi leadership officer), these men, recruited from ardent members of the Party, are to superintend the political "education" of German soldiers and airmen.

"During the crises to come," said one of the newly appointed morale-boosters, "the slogan under which we are fighting this war must prove strong enough to preserve the will to resist despite all strains."

It is significant that in the fifth year of war the Germans should find it necessary to establish political commissars. In Russia the process has been the exact reverse—created shortly after the revolution, the institution of political commissars was abolished during the present war.

The German innovation may well be a sign of the reappearing rift between the *Wehrmacht* and the Nazi Party.

Luftwaffe in Finland

ACCORDING to a report in "*Sé*," the *Luftwaffe* disposes in North Finland of 1,200 aircraft and the strength of the personnel is 7,000, including A.A. troops. This force is mainly distributed on the Helsinki, Knopio, Abo, Vaasa, Bjoerneborg and Kemi airfieds.

North of the Kemi-Kunsamo line, the *Luftwaffe* maintains an additional small force of 700 aircraft, of which 200 are bombers.

Precautions

FROM Malmö it is reported that after the recent American attack on Kjeller the Germans have taken comprehensive precautions at Sola and Fornebu airfields and at the engineer repair workshops at Aker. A.A. defences of the area have been reinforced.

Apparently in anticipation of an Allied airborne invasion of Fornebu, the Germans have surrounded the whole airfield with bunkers and increased the obstacles and defence posts on the road to Oslo.

Going Down

GERMAN aircraft factories have now been very largely transferred underground in gigantic dug-outs, according to Bernard Lescrinier, military correspondent of the German European Radio, quoted by Reuter. "These underground factories are protected by natural camouflage—narrow valleys, high mountains and enormous forests," said Lescrinier. "The factory halls are lit by special quartz lamps, and a suitable temperature is artificially maintained. Fresh air is sucked in from the height of woody mountains and heated or cooled according to the season. The workers diet is prescribed in detail by the factory doctor, and in addition all underground workers are given doses of vitamins and other medicines based on secret prescriptions."

"Welfare personnel amounts to 5 per cent. of the total staff compared with 1 per cent. in other factories."

What They Say

MARTIN HALLENSLEBEN chief military correspondent of the German News Agency:

"This air invasion by increasingly active British and American formations over West, South and Central Europe has without doubt the aim of weakening Germany's possibilities of hitting back and impairing both the strategic and tactical mobility of her defence. The air invasion has two immediate aims: (1) To weaken Germany's fighter defence, and (2) to pave the way for the invasion by ground forces. As they get ready for a general offensive, they aim at an initial paralysis of Germany's mobility.

"They have to do this in order to be able afterwards to break through all obstacles and natural impediments and conquer. At the moment the button is pressed and the Allied invasion machinery hums into full swing, the Germans will have the advantage of the shorter—that is the inner line. The Allies are therefore intent on eliminating this initial German advantage to facilitate their 'Second Front' on the ground.

"The General Staff of *Luftwaffe* is now talking of its own 'Second Front.' By this it means those reserves which it will use only when the curtain rises. German air industry is weekly adding new formations to this 'Second Front' reservoir.

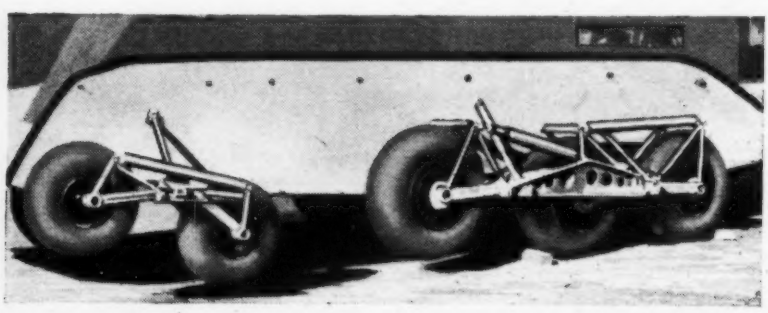
"We are for obvious reasons unable to reveal what percentage of the German aircraft industry is by now working in underground factories. We confine ourselves to saying that Germany foresaw the Allied offensive on her air production and took the necessary steps long before the British and American 'air invasion' began."

Karl Zeppelin, air correspondent of the German Overseas News Agency: "The Allied invasion will be launched at a moment when atmospheric conditions are favourable to flying. Well-informed German military circles are of the opinion that flying conditions will be the decisive factor for the landings in view of the unsurpassed number of aircraft which will be employed by the Allies."

Der Goebbels-Vogel

A DEMOLITION squad digging in the heap of rubble that had once been a power station, heard a thin, monotonous and persistent voice coming up from the wreckage.

They dug furiously and finally unearthed a parrot which was saying over and over: "No military objectives were hit."

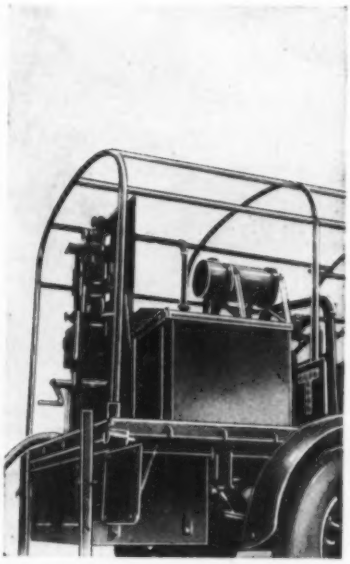


The double bogey undercarriage of the Me 323 "Gigant." The weight is normally supported by the six-wheel main bogey, the four-wheel front bogey coming into action at landing and when loading through the nose.

The ancients honoured water and its source of supply by making Aquarius, the Water Bearer, one of the signs of the Zodiac, ruling the heavens in January and February.

While the presence of water has always meant life, water-carelessness has meant infection and death.

Now modern brains have solved an old worry. The secret is a little electrolytic cell in a black ebonite case, scarcely larger than a clenched fist, which makes and injects exactly the amount of fresh electrolytic sodium hypochlorite needed to render safe water which is being pumped from any doubtful source.



The device enables E.C.D. water treatment apparatus to deliver clean, fresh water, without taste, colour, smell, or taint — even though the original supply may have been organically polluted almost beyond belief.

Not only is the water obtained absolutely hygienic and free from all bacterial infection, but it can be stored for many hours without losing its freshness.

Various sizes of E.C.D. equipment give from 500 to 3,000 gallons of pure water hourly.

Advice on matters relating to water treatment can be obtained from

ECD

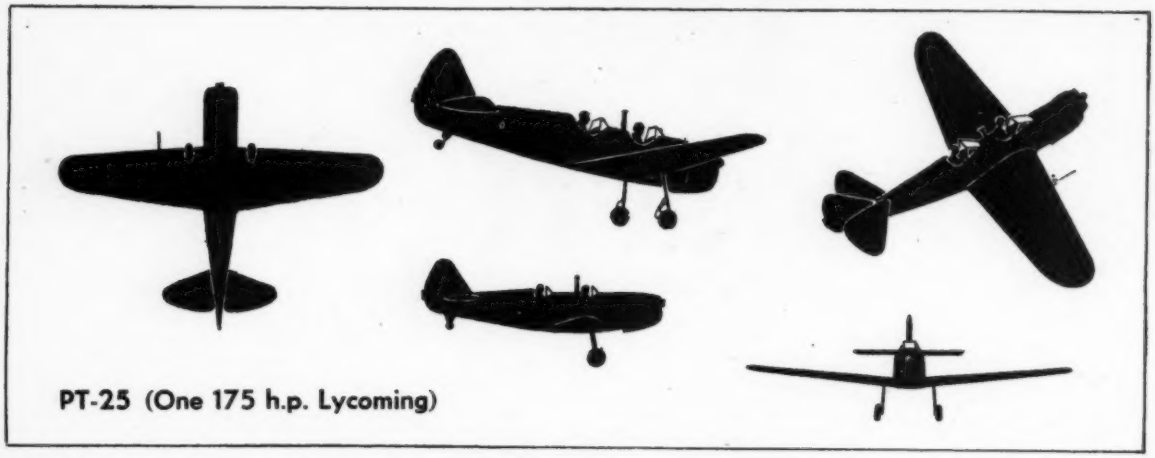
WATER TREATMENT

E.C.D. LTD. · TONBRIDGE · KENT · TELEPHONE: TONBRIDGE 737

E

Studies in Recognition

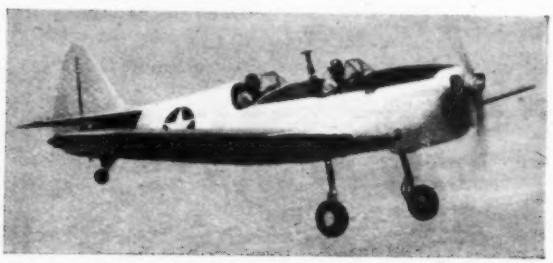
Aircraft in F



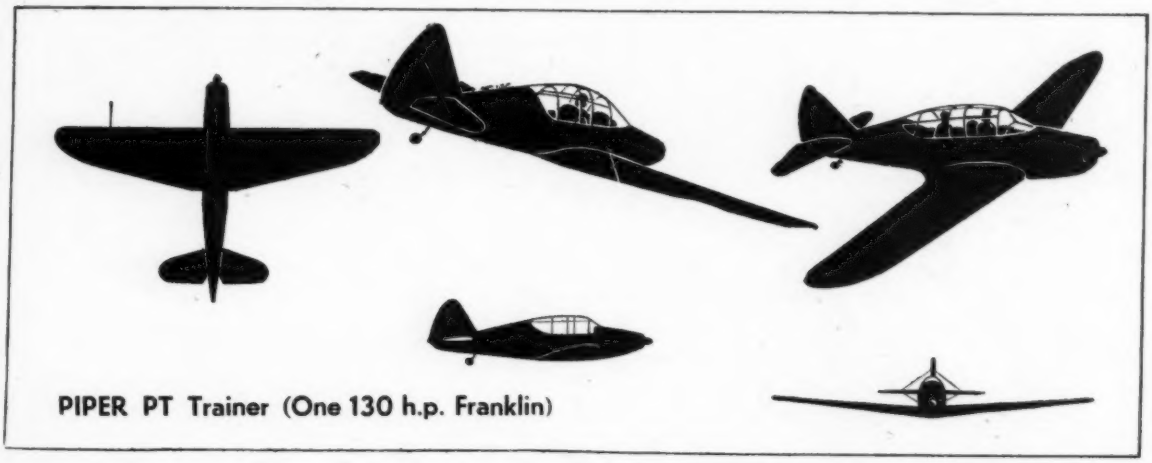
PT-25 (One 175 h.p. Lycoming)

BUILT almost entirely of plastic-bonded wood, the Ryan PT-25 was introduced about two years ago to replace the then current PT-22 when the U.S. authorities asked the firm for a trainer built of "non-strategic" materials. Nowadays, however, it is questionable if wood is more readily available than steel and light alloys for non-combatant aircraft, according to recent statements from America.

Although larger in overall dimensions than its metal predecessor, the PT-25 is lighter and, having a more powerful engine in the 175 h.p. "flat-six" Lycoming, has a much better performance. Top speed is 149 m.p.h. Recognition features differ materially from the PT-22, which had external bracing The cantilever wings of the PT-25 taper to rounded tips, the tailplane is the "wing-nut" type and the fin and rudder taper to a small round apex. The fixed cantilever undercarriage is unfaired. Dimensions: Span 32ft. 11in.; length 24ft. 3in.; height 6ft. 8in.; wing area 161.2 sq. ft.



Ryan PT-25 Two-seater Trainer.



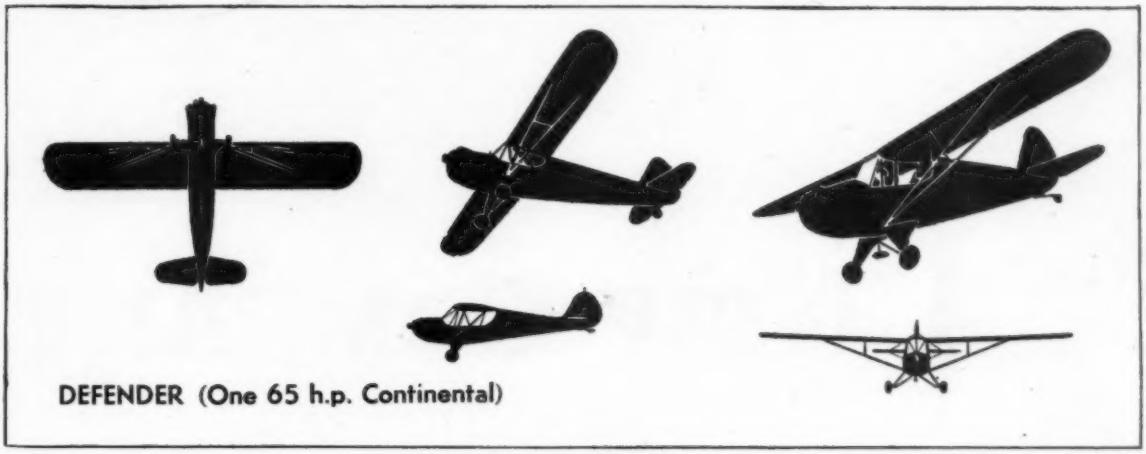
PIPER PT Trainer (One 130 h.p. Franklin)

Piper PT Two-seater Trainer.

THE name of Piper has always been associated in the past with strut-braced high-wing monoplanes of the "grasshopper" type, but there is nothing experimental-looking about their first low-wing trainer, which is a particularly clean and workmanlike job possessing the unusual refinement of a retractable undercarriage. Powered by a 130 h.p. Franklin "flat-six" engine, the top speed is 150 m.p.h., but a more powerful engine can be fitted, if required, without any structural changes. Another "luxury" for a machine in this class is the provision of slotted flaps.

Recognition points include a small rectangular centre-section with outer panels tapering on the trailing edge only to small curved tips; wire-braced tailplane tapering on leading edge only, and curved trailing edge to tapered fin and rudder; oval sectioned fuselage with streamlined covered cockpits. Dimensions: Span 34ft.; length 22ft. 10in.; height 6ft. 6in.; wing area 164 sq. ft.

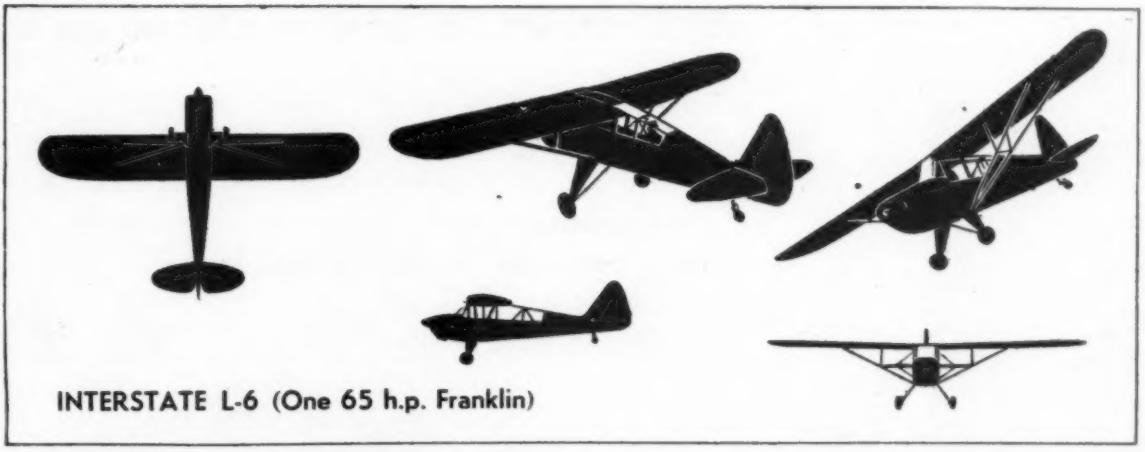
Flying Attitudes



DEFENDER (One 65 h.p. Continental)

Aeronca Defender and L-3C.

TWO versions of the Aeronca are in service with the U.S.A.A.F., the L-3C liaison model, and the Defender two-seater trainer illustrated here. Both are in the true "grasshopper" class, being powered by an engine of only 65 h.p. This is generally a Continental "flat-four" but may be a Lycoming or Franklin. Basically the two models are similar, but the L-3C has extended transparent areas in the roof and cabin sides for observation purposes. Both have tandem seating accommodation, but whereas the Defender has normal dual control, the L-3C may have the observer's seat facing aft to facilitate provision of a map table. In either case top speed is 95 m.p.h. Common recognition points include parallel-edged high wing with round tips braced by back-staggered V struts and triangulated inter-struts; tapered wire-braced tailplane with round tips; large curved fin and rudder; fixed undercarriage. Dimensions: Span 35ft.; length 21ft. 10in.; height 9ft.; wing area 169 sq. ft.



INTERSTATE L-6 (One 65 h.p. Franklin)

AS its U.S.A.A.F. designation indicates, the Interstate was the sixth type of light civil aircraft to be adopted by the Army for liaison duties, and the L-6 is the military version of the civil Cadet; the only visible difference being the usual extension of its cabin transparent area. The Cadet is used by the schools operating under the Civilian Pilot Training Plan. Both versions are powered by a "flat-four" 65 h.p. air-cooled Franklin or Continental engine and have a top speed of 107 m.p.h. Tandem two-seater accommodation is the same as for the two respective versions of the Aeronca. All liaison "grasshoppers," of course, are equipped with wireless.

Recognition as between one "grasshopper" and another is not easy as nearly all have strut-braced parallel-edged wings with rounded tips, but the Interstate can be told by its elliptical tailplane and the shape of its large fin and rudder. (Compare illustrations with Aeronca above.) Dimensions: Span 35ft. 6in.; length 23ft. 3in.; height 7ft.; wing area 173.8 sq. ft.

Interstate L-6 and Cadet.

ANNOUNCEMENT

A NEW COMPANY

Light metals will play an indispensable part in solving the mechanical and structural problems of the future. A new company has been formed by

HIGH DUTY ALLOYS LTD

REYNOLDS TUBE CO. LTD

REYNOLDS ROLLING MILLS LTD

to collaborate with designers and constructors in any industry to secure the best use of Hiduminium Alloys. Further information will be sent on request to Hiduminium Applications, Ltd.

HIDUMINIUM APPLICATIONS LTD.

ALUMINIUM ALLOYS · FARNHAM ROAD · SLOUGH · BUCKS

Power Plant — Past and Future

Geometric Layout and Number of Cylinders : Engines of 8,000 h.p. by 1960 : Jet Propulsion and Gas Turbines : Great Britain's Pioneer Work

(*Concluded from page 583*)

THE first half of the précis of the 32nd Wright Memorial Lecture read by Sir Roy Fedden before the Royal Aeronautical Society was reported in last week's issue of *Flight*. Following are the remaining sections of the paper.

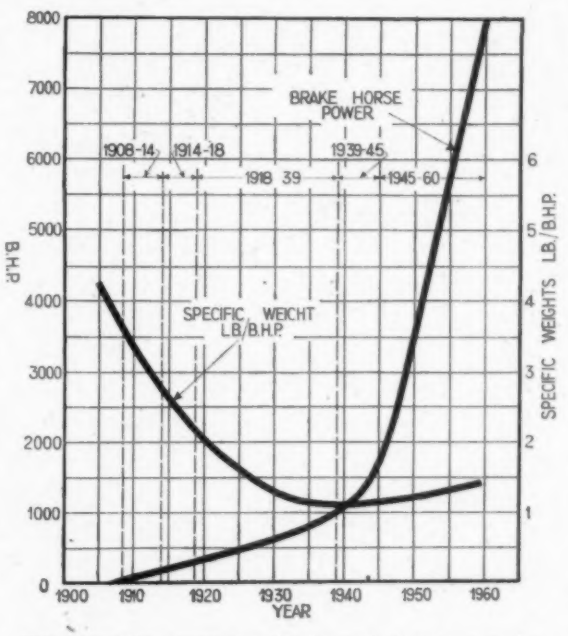
Sir Roy pointed out that although when the war is won we shall obviously continue to provide power plant for our military air force for policing purposes, and also for civil aircraft, we shall employ engines that are available at the time, but we have learned so much during the present war that there are considerable strides that can be made for the future.

In principle, Sir Roy continued, I am averse to adapting military engines for peace-time use although, obviously, we shall not throw away all the remarkable experience we have gained during the war. As soon as is practical we must develop a new family of engines for civil use, and we must approach this goal with a different outlook, giving the maximum attention to long life between overhauls, minimum maintenance costs and servicing, and, above everything, low drag and low fuel consumption.

Turning now to this new family of engines, one of the first big questions is that of the breathing mechanism, and I am of the opinion that we should do well to select the Burt McCollom sleeve valve with bores of up to 6½ inches for air-cooled cylinders, and 7½ inches for liquid-cooled cylinders, in the latter case giving outputs of something in excess of 200 h.p. per cylinder.

It is difficult to be so categorical about the pros and cons of air and liquid cooling for future high-power air transport power plants. Air-cooling was predominant all over the world in civil aircraft before the war, due to the fact that early civil airliners had employed the old type of somewhat complex liquid-cooled engine with separate cylinders, presenting an entirely different proposition from the modern, properly conceived, liquid-cooled, self-contained power plant. Further, the liquid-cooled engine should be slightly better on fuel consumption, and should have advantages in buried installations, although there is much to be said for the air-cooled engine whilst the conventional nacelle mounting is retained.

There is no doubt that for the air-cooled engine the ultimate development of integral finning technique is being approached, and the latest type of special finning lathe completes the whole fin-cutting operation in six minutes, cutting 52 fins with 104 tools and removing 20 lb. of metal in the process.



This shows the progressive development of average engine powers and specific weights, over the last 40 years, and assumed curves for the next 16 years.

In view of the fact that there are likely to be big developments in the future on the gas turbine, which may supersede the reciprocating engine in due course, it would appear that there is insufficient time left to develop piston engines incorporating any major new principles, and the builders of such power plants of the future should make hay while the sun shines with proven geometric layouts.

Assuming the state of the war will allow us to devote sufficient energy to new designs during the next twelve months, and accepting that any large aircraft engine takes five to six years to develop and bring to a satisfactory state of production, the post-war family of engines which are envisaged should come into use about 1950, and will then have a useful life of five to ten years, during which time we are likely to see the gradual decline of the piston engine in favour of the gas turbine.

It will be seen from the chart that the power/weight ratio of conventional engines which, in 1905, averaged just over 4 lb. per h.p., dropped steadily until it stabilised at about 1.1 lb./h.p. in the late 1930s, when outputs reached about 800 h.p. The curves have been extrapolated on what seems to be a reasonable basis, and indicate that by 1960 we may expect to see engines of 8,000 h.p., while the power/weight ratio shows a slight upward trend.

Basing our predictions on a maximum of about 200 h.p. per cylinder, it will be worth while devoting a short time to assess the potential power output of the various practical types of engines. It would seem the Rolls-Royce Griffon represents about the peak size for 12 cylinders, and we may expect at least 2,400 h.p. from this type of engine in the next few years. The V-16 is attractive on account of its small cross-sectional area, but it is long and the crankshaft system is difficult. The X-24 has been constructed, in prototype form, in many countries during the last 25 years. In general terms it is not considered economical to transmit more than 3,000-4,000 h.p. through a single crankshaft: this layout is practicable for powers up to that figure.

In order to alleviate these difficulties, the X-24 twin-crank is suggested, and although for high powers this engine has advantages for air-cooling, it does not seem as attractive as the H twin-crank for liquid-cooled engines. The W-24 twin-crank seems a logical development as an emergency, but it is believed that this design could only be considered as a wartime policy, the H-24 twin-crank being a more compact solution. The Napier Sabre of 2,200 h.p. has already proved this design to be a classic liquid cooled

POWER PLANT—PAST AND FUTURE

type, and we may see ultimate powers up to 6,000 b.h.p.

The twin-row, air-cooled radial has also proved to be a classic type, and in the course of the next few years it is expected that we may see outputs exceeding 3,000 h.p. from 18 cylinders. The logical successor to this engine is the 28-cylinder, and we may expect to see 4,000-5,000 h.p. from such a layout. In an attempt to establish the largest practicable engine from a combination of known cylinders and geometric layout, a six-row, liquid-cooled radial with seven cylinders per row, giving a total of 42 cylinders is practicable and could develop over 8,000 h.p. It is suggested that all the foregoing engine layouts are worthy of attention; each manufacturer, however, is bound to have his own ideas.

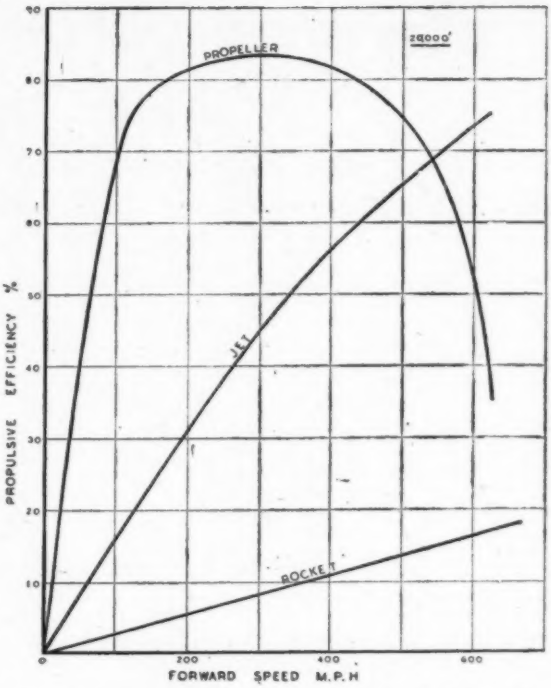
Importance of Drag Reduction

Turning to the future weight of power plant, one of the illustrations shows the trend in specific weights of various British and American engines representative of good practice on air and liquid cooled power units. The full line, representing the liquid-cooled engines, flattens out at about 1 lb. per h.p. after the 1,200 h.p. mark, while the dotted line indicating the air-cooled engines, crosses over at 800 h.p. and flattens out to a value of 1.2 lb. per h.p. It is interesting to note that for types of over 1,000 h.p. there has been little reduction in specific weight.

The advent of the gas turbine has shown how well this new form of prime mover can be installed, and unless the installation of the reciprocating engine is taken more seriously in the future, it may be rapidly overtaken by the turbine.

Although the quickly detachable "standard" power plant will remain with us for some years yet, the reduction of drag will become so important that the engine must eventually be completely buried within the envelope of the wing, except possibly on the smaller type of civil aircraft. It is of interest to note that we in this country, as well as the Germans, had buried engines and shaft drives in an experimental stage at the end of the last war. For long-range fighter or mailplanes it is considered that buried engines are important, and such an arrangement is shown diagrammatically. The scheme overcomes the objection to the interference which is inevitably caused by three comparatively large projections on a thin, low-drag wing of about 60ft. span. There are two air-cooled radials with combined bevel drive, extension shafts and right-angled geared drives to the three-blade tractor airscrews.

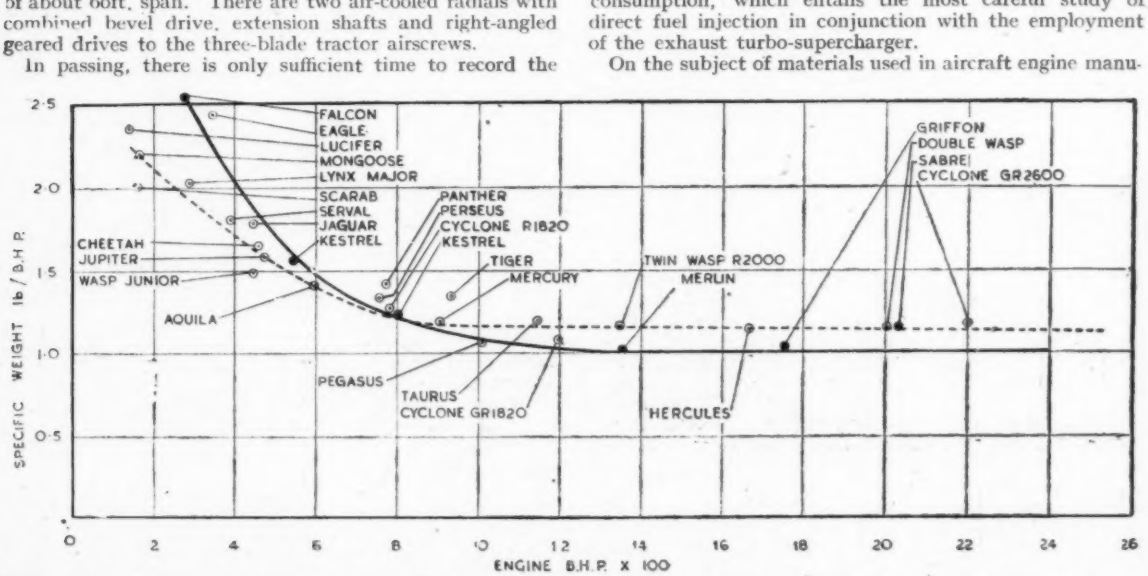
In passing, there is only sufficient time to record the plea that on future power plant, with the probable introduction of 200-volt alternating current in aircraft, auxiliary engine drives should be eliminated to the utmost, and all-electric operation introduced instead.



Curves of propulsive efficiency against speed at 20,000ft. for airscrew, jet, and rocket indicate clearly the respective limitations of the conventional and latest forms of propulsion.

To sum up this section of the paper, there is no doubt that we are about to enter, through the medium of the gas turbine, the era of ducts, and it is suggested that the future and continued life of the normal reciprocating engine will only be realised to the full if admitted to co-partnership so far as ducted installations are concerned. To this must be added the necessity of obtaining low specific fuel consumption, which entails the most careful study of direct fuel injection in conjunction with the employment of the exhaust turbo-supercharger.

On the subject of materials used in aircraft engine manu-



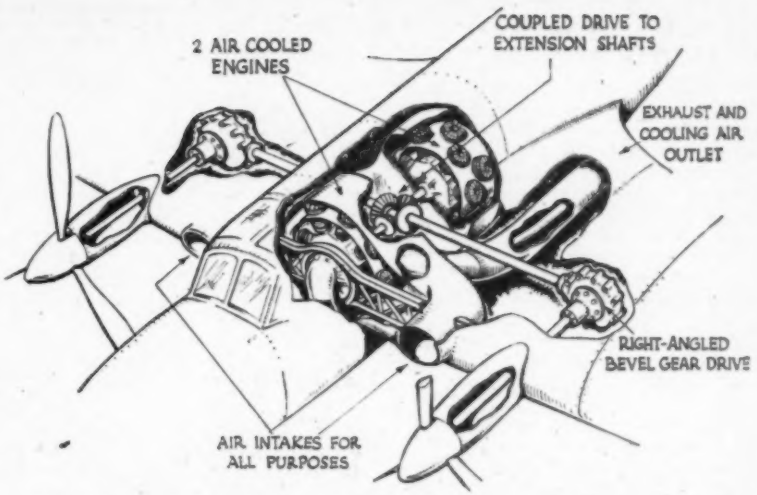
The trends of specific weights of selected British and American air-cooled and liquid-cooled engines. It is worthy of note that for units of over 1,000 h.p. there is little reduction in specific weight.

facture Sir Roy expressed the opinion that there will be an urgent need, after the war, for suppliers to introduce improved materials for aircraft engines, which will generally help the breed and will enable higher power outputs and greater reliability to be obtained.

Whilst asking for still better quality there is also the question of cost, which is going to be of primary importance in the future. This is a broad question affecting the whole of the raw material industries starting from coal and power production, through the producers of the primary metals to steel and light alloy fabrication, and cannot be divorced from the technical aspect of future development. If this country is to maintain its position in the forefront, he submitted that the producers of the primary metal must approach this whole subject with considerable vision, and the pre-war cartels must be abolished if we are to compete fairly with other industrial countries.

One other development to which I would like to refer, Sir Roy continued, is powder metallurgy. This is an interesting technique, which places a new tool in the hands of the material manufacturers which may well enable them, by its proper development and use, to meet some of the demands for improved properties of materials for aircraft engines.

During the last war two-bladed wooden airscrews and, in a few instances, two-piece four-bladers were standard practice in the air forces of all the combatants.


2 AIR COOLED ENGINES
COUPLED DRIVE TO EXTENSION SHAFTS
EXHAUST AND COOLING AIR OUTLET
RIGHT-ANGLED BEVEL GEAR DRIVE
AIR INTAKES FOR ALL PURPOSES

This installation, comprising two air-cooled radial engines driving through shafts and gearing the twin airscrews, successfully eliminates the parasite drag of bulky nacelles.

British Pioneering

As has so often happened in other branches of aeronautics, we, in this country, pioneered both metal blades and variable pitch airscrews, and in November, 1918, a variable-pitch four-blader of Farnborough design, in conjunction with an exhaust-turbo-supercharged engine, was flown in an R.E.8 aircraft. Shortly after the war successful hollow steel blades were developed by Dr. Watts, and a fully automatic, hydraulic constant-speed airscrew was patented by Hele-Shaw and Beacham. Other Hele-Shaw airscrews were successfully endurance-tested in experimental aircraft, but all this pioneer work faded away without coming to production fruition, and America was the first to appreciate the practical value of the variable-pitch airscrew, realising that, in spite of its extra weight, it paid good dividends providing the machine had the correct wing and power loading.

The present war found this country only partly adapted to variable-pitch airscrews, and although our bombers were so fitted it was only just before the Battle of Britain that many of our fighters were also converted, thus giving them greatly improved performance in the "nick of time."

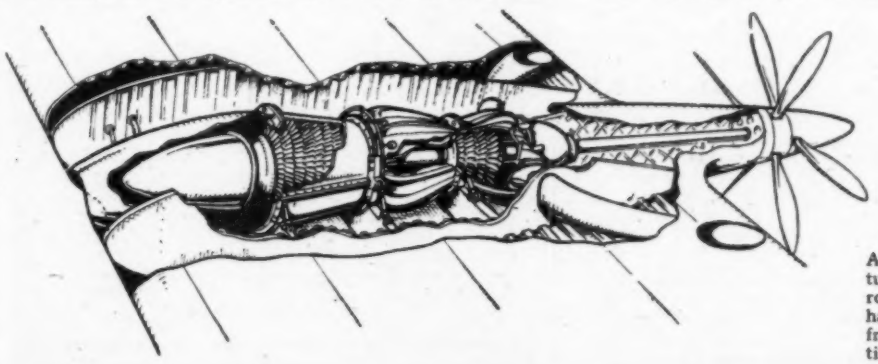
The whole question of airscrew efficiency at high speeds and high altitudes is becoming more complex, and it is therefore necessary to link the airscrew more closely with the power plant. In the case of the gas turbine this is absolutely essential, and there is no doubt that the advent of the latter has caused us furiously to think about realising the better combination of power plant and airscrew with the conventional piston engine.

Weight factors are of the utmost importance on future high-power variable-pitch airscrews. The search for new blade materials will always be uppermost in the minds of designers, and it is expected that the solid duralumin blade may not be able to hold its own above 15ft. diameter. Alternatives are compressed wood, hollow duralumin, and hollow steel. America has done much useful work on the steel blade, and eventually this may prove to be the ideal solution owing to its strength, durability and robustness.

The exploration of the airscrew for high-power, high-performance aircraft has now become a major undertaking, almost equal in magnitude, length of time and cost, to that of the engine itself. Without the suitable equipment and the financial resources, it will be impossible to achieve adequate results to keep pace with engine and airframe development. It is of the utmost importance that all this work should be tackled on high priority, and that engine and airscrew makers should keep in the closest touch with each other.

To overcome the relatively low efficiency at low speeds with jet engines, it would appear essential to supplement the jet with thrust augmentors, either in the form of ducted fans or airscrews.

All of us are now aware that vital developments are taking



A multi-stage, axial-flow gas turbine unit driving contra-rotating pusher propellers and having secondary propulsion from jet-reaction, the proportion being probably of the order 70:30.

POWER PLANT— PAST AND FUTURE

place with gas turbines and jet engines for aircraft propulsion, and there can be little doubt that in the course of time the gas turbine in its various forms will, with the necessary development, gradually supersede the piston engine as the source of power for the aircraft of the future.

Although the possibilities of the gas turbine as a prime mover have been investigated by various authorities over a period of more than 30 years, it can justly be claimed that Great Britain has played a leading part in the application of the continuous combustion turbine for aircraft propulsion.

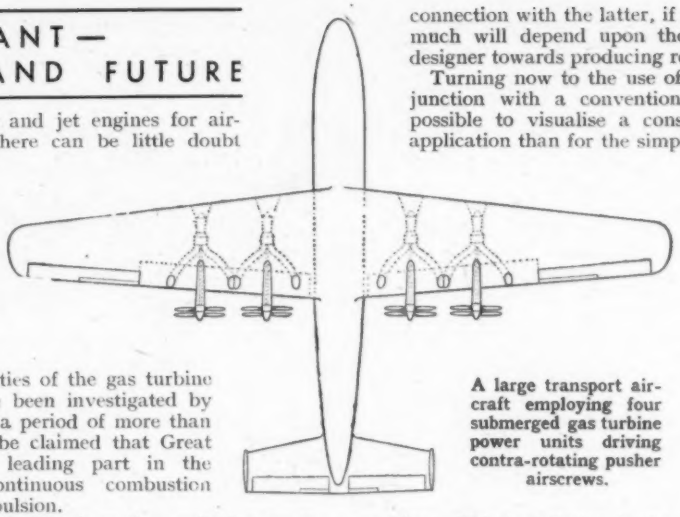
Grp. Capt. Whittle must be given the credit for appreciating the possibilities of adopting the gas turbine for use as a jet-propulsion unit, and this country further owes a debt of gratitude to him and his colleagues, as well as to the staff of the Royal Aircraft Establishment, for the vision and perseverance put into the whole problem of the gas turbine in its difficult initial stages of development.

Use of the Gas Turbine

The propulsive characteristics of the gas turbine and jet combination differ fundamentally from those of the piston engine with airscrew, and an illustration shows curves of propulsive efficiency against speed, at 20,000ft., for the conventional airscrew, jet, and rocket. It is seen that the airscrew achieves its maximum efficiency at about 300 miles per hour, while the cross-over point occurs at about 550 miles per hour.

There is undoubtedly a great future for the jet-propelled aircraft in the high-speed, high-altitude field, both for military types and special-purpose civil aircraft, but in connection with the latter, if they are to be a success, much will depend upon the efforts of the aircraft designer towards producing really low-drag machines.

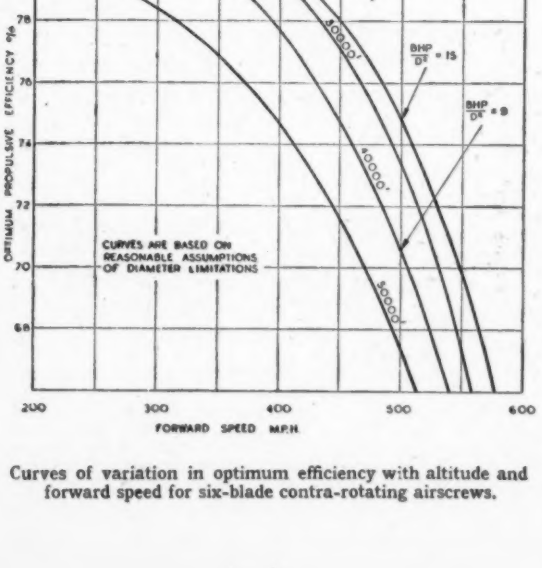
Turning now to the use of the gas turbine in conjunction with a conventional airscrew, it appears possible to visualise a considerably wider field of application than for the simple jet unit. Such power plant will probably be of the multi-stage, axial-flow type, employing between 70 and 80 per cent. of the power output to drive the airscrew, and the remaining 20 to 30 per cent. for jet propulsion. The illustration shows an impression of such a unit driving contra-rotating pusher airscrews, and completely submerged in the wing of a large machine. This installation is shown with divided exhaust ducts discharging outside the airscrew disc, but there will undoubtedly be many alternative methods of installing such a power plant.



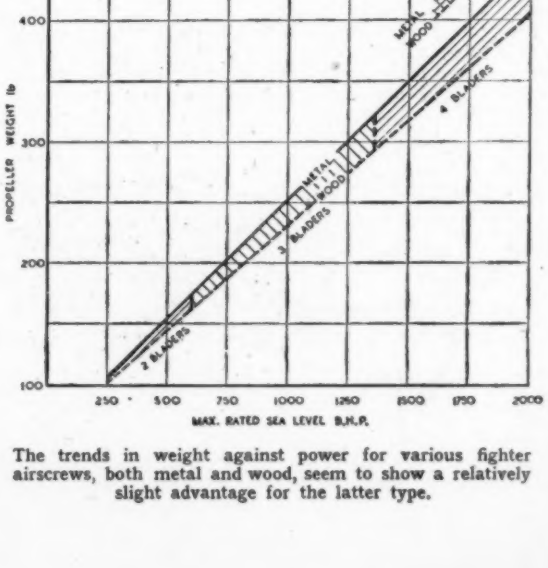
A large transport aircraft employing four submerged gas turbine power units driving contra-rotating pusher airscrews.

There is still much to be accomplished, and adequate efficiency, flexibility, and stability of operation of multi-stage, axial-flow compressors and turbines will only be achieved by patient development, and, in addition, there will be many problems on turbine materials, blade vibration, differential expansion, etc., to be solved. Every encouragement should be given to the evolution and manufacture of new types of promising design, but with the gas turbine, as is the case with the conventional aircraft engines, we must plan our development programme wisely, be prepared to take one step at a time, and not be tempted to rush into production with partially developed designs.

However, when the gas turbine has been developed and brought to fruition, we may expect to have prime movers with altogether new standards of reliability and performance. Some outstanding advantages should be reduced drag and weight of power plant, the provision of a smooth



Curves of variation in optimum efficiency with altitude and forward speed for six-blade contra-rotating airscrews.



The trends in weight against power for various fighter airscrews, both metal and wood, seem to show a relatively slight advantage for the latter type.

POWER PLANT— PAST AND FUTURE

torque characteristic, elimination of mechanical clatter and intermittent exhaust noise, and possibly the use of kerosene, or some similar high flash-point fuel. In addition, when the fundamental design factors have been firmly established, and advantage can be taken of the scale effect, we can expect the rapid realisation of power units for specific application, even in the very high-power class, and thus achieve that ideal state whereby the manufacture of prototype aircraft, together with "tailor made" and properly matched power units, can be effected simultaneously. This, as we know, has not been possible with reciprocating engines up to the present time, and the aircraft designer has, in the past, been faced with the alternative of taking a chance with new types of partially developed engines, or fitting proven marks which set a limitation on the performance and design of the machine.

We are undoubtedly on the verge of a new era in aircraft power plant, and it is for the aircraft designer to show the way as to how these new prime movers can best be employed.

From what has been said, it will be gleaned that, on the whole, this country has every reason to feel satisfied that it has taken a foremost place in the evolution of prime movers for aircraft for the last thirty years, and that when this war ends we shall possess a family of high-output military aircraft engines which is second to none in regard to power at altitude and the maximum utilisation of a given pound of material.

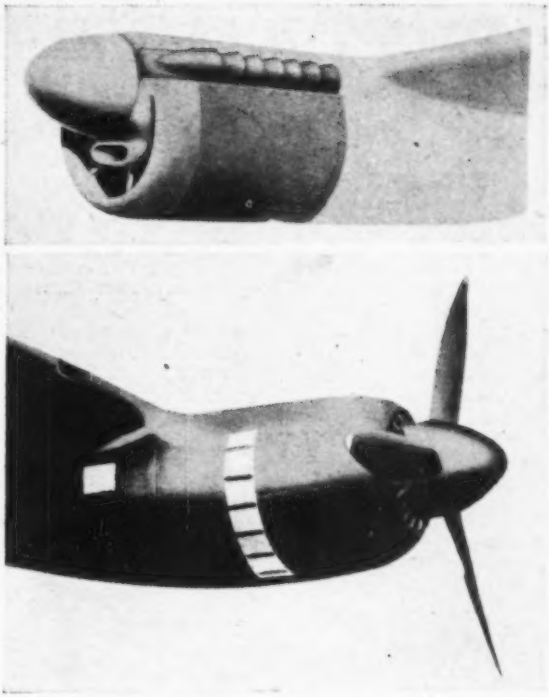
Concerted Post-war Programme

It is submitted that what we have to do for the future is to face up to a carefully planned scheme, which will ensure enthusiasm, keenness, and co-ordinated team-work from the whole country, both in regard to the development of improved materials as well as the actual power plants themselves. Further, that we must make sure that there will be no lull or slipping back whatsoever after this war, and that we shall have a concerted and adequate research and development programme covering the whole field and extending for at least ten years.

I started this paper by saying that at the dawn of aviation, aircraft pioneers had been waiting on the evolution of a satisfactory and light enough power plant, which statement, in broad principle, holds good to-day, insomuch that if we are going to see the improvement in cleanliness and streamlining of aircraft which we believe is possible, and the step-up in speed which we think is still to come, then the engine designer and power plant engineer must continue to produce better and more efficient complete power plant units.

The position, however, is somewhat reversed in modern times as regards the initiative compared with what has been the case in the past. With the prospect of the gas turbine being built-in within the envelope of the wing, and the stimulus that this will give to improved and ducted conventional piston power plant, the ball is, I submit, in the court of the aircraft designer, and it will be necessary for him to produce airframes of considerably reduced drag in order to pay adequate dividends on the new power plants, which we believe are just round the corner.

There is no need, however, for us to fall out as to where the responsibility lies, and this suggestion is simply thrown out as a spur to the aircraft designer of what is expected from him in the future: the engine fraternity are under no delusion as to what they have on their plate for the next ten years. Aircraft power plant has arrived at an inspiring position, and, providing we can have the right leadership, the future generation of young engineers in this country, who will have the privilege of working on this highly interesting branch of engineering, should have great opportunities. As I have endeavoured to bring out, aircraft-engine development is one of the most precise forms of engineering, but the designer and engineer have a unique opportunity to give vent to their initiative and imagination, as the very nature of the work enables them to employ materials, and methods, which are prohibitive in any other branch of internal combustion engineering.



(Above) The latest proposals in power-plant design include a circular cowling section for in-line engines, and a modified form of flame-damping, ejector exhaust stacks. (Below) The radial, air-cooled power plant, which is complementary to the in-line type, looks far more orthodox but makes use of an auxiliary cooling fan, presumably mounted on the spinner.

It is desired to emphasise that this country has pioneered the world in the development of the gas turbine for aircraft purposes up to the present time, and it is important that we should ensure that there is no chance of our losing the lead in this respect. Some people are most concerned that we are in danger of doing so, and it is sincerely hoped that those in authority will see to it that the outstanding work that has been accomplished in this country to date is not lost and left for others to bring the initiative and imagination of our technical brains to practical fruition, while our own effort falls away.

Such was the case, notably, with the variable-pitch airscrew and the retractable undercarriage, both of which were originated and tested-out in this country in practical form for years, but for which there was not enough vision and drive put behind their development to bring them to rapid realisation for everyday use.

The jet-propelled, high-speed fighter is already with us, but at the same time it is equally important that we should keep our balance and sense of proportion in regard to gas turbine development generally. Whereas the possibilities of this prime mover are undoubtedly very great, and it will presently replace the conventional engine in a number of different types of aircraft, the piston engine is by no means finished, and, at any rate for the longest-range aircraft, will hold the field, in my opinion, for at least ten years. It is for this reason that we must ensure high priority on a logical new family of powerful, reliable, and economical piston engines, planned on a basis to make use of new developments and improved materials to the best possible advantage, designed in a realistic way, and built as complete power plants.

Anglo-American Aircraft Production

Striking Power as Criterion of Progress : Quality Allied to Quantity : Extent of Repair for Aircraft and Engines

A STATEMENT on the extent of British aircraft production in the United Kingdom was given recently by Sir Stafford Cripps, the Minister of Aircraft Production, as a supplementary statement to the release by the Aircraft Production Board of the U.S. War Production Board, of figures for the joint British and American production of aircraft.

Sir Stafford said that the number of home-built aircraft delivered in the twelve months ended March, 1944, was in excess of 27,000 of which but 17 per cent. were trainers and non-operational types. This, compared with the total production of 2,000 in 1936, under 3,000 in 1938; 8,000 in 1939 and over 15,000 in 1940, shows the really grand job of work the country has done in this sphere. The aircraft reproduced are larger and better year by year, and a comparison by numbers alone substantially underestimates the progress we have made. To afford a clearer picture, the production of aircraft structure weight during the last year was nearly 200,000,000lb. This is over fifty times greater than the weight of air frames produced in 1936; seven times the weight produced in 1939, and almost four times the weight produced in 1940.

These figures do not tell the whole story, however, since weight for weight the machines we are now turning out are superior to those we made even so recently as last year.

Sir Stafford pointed out that the best criterion of progress in aircraft production is, of course, not by numbers or weight, but by striking power against the enemy. Bombers, for instance, are only useful if they can deliver a large load of bombs on the enemy, and we have made considerable progress in this direction. The aggregate bomb load of the whole of our bomber production in the twelve months ended March this year, measured for one 1,000-mile trip per aircraft, totals 35,000 tons. The same basis of calculation applied to our production in the year ended December, 1940, gives the figure of only just over 4,500 tons. The carrying capacity per lb. of airframe weight is to-day almost double that of the 1940 machines, and, on top of this, there is the tremendous improvement in range and speed of our present aircraft.

Quantity alone may be a misleading criterion of the actual value of the country's output. Sir Stafford expressed the view that, had we wished to stay on the production of those aircraft which we were making in 1939 and 1940, without changing over to new and improved types, we could have had by now a much greater production both in numbers and weight. Instead, we have been continually improving existing types and producing new ones; and we are now turning out sixteen types of aircraft which were not in production in 1940, and, in addition, there are still further new types due to come into production within the next year.

The British aircraft industry, apart from producing new aircraft, does a substantial volume of repair. During the last twelve months, in addition to producing over 27,000 new machines, the industry effected major repairs to a further 18,000, thus making available 45,000 aircraft. Not only this, but the output of spares of all kinds, including spare components, has increased very substantially and is now equivalent to 50-60 aircraft for every 100 complete aircraft built.

Deliveries of aircraft engines during the last year fell just short of 60,000. The horse-power equivalent of this engine production was 5½ times as great as the production in the first twelve months of the war. The engine repair programme is numerically greater than the aircraft repair programme and to-day is approximately at the rate of 45,000 engines per year.

Sir Stafford said that the United Kingdom industry has given substantial technical and expert assistance both to the United States and the Dominions in their own aircraft production. Thus it was at the instigation of this country that the production of Merlin engines was started in America, and the Americans now rely on this engine for one of their most outstanding types, the Mustang. We have helped to start production of our more successful types, such as the Mosquito and the Lancaster in Canada and Australia.

For a country of this size, added Sir Stafford, which is right on the enemy's doorstep, we have every reason to be proud of what we have achieved in aircraft production. During the most critical period of its growth in 1940, the industry was subjected to very heavy bombing, but it managed to surmount its difficulties and production has been on an ever-rising trend since.

A year-by-year structure weight table was also given.

CIVIL AVIATION'S THREE PROBLEMS

SIR FREDERICK HANDLEY PAGE told the Roadfarers' Club at a luncheon in London last week-end that there were three civil aviation problems to be considered. First, we had to make certain that it was safe for everybody to fly.

Secondly, we had to deal with the question of how much we were going to allow air lines to be operated all the world over without involving every country or every company in bankruptcy because of the extreme cost or the difficulties of running air lines.

The third point was the kind of aircraft that were to be produced.

He visualised transport machines not larger than some of the big bombers of to-day, forecast extensive development of the helicopter, and said that the future in the air lay in the long-distance transport.

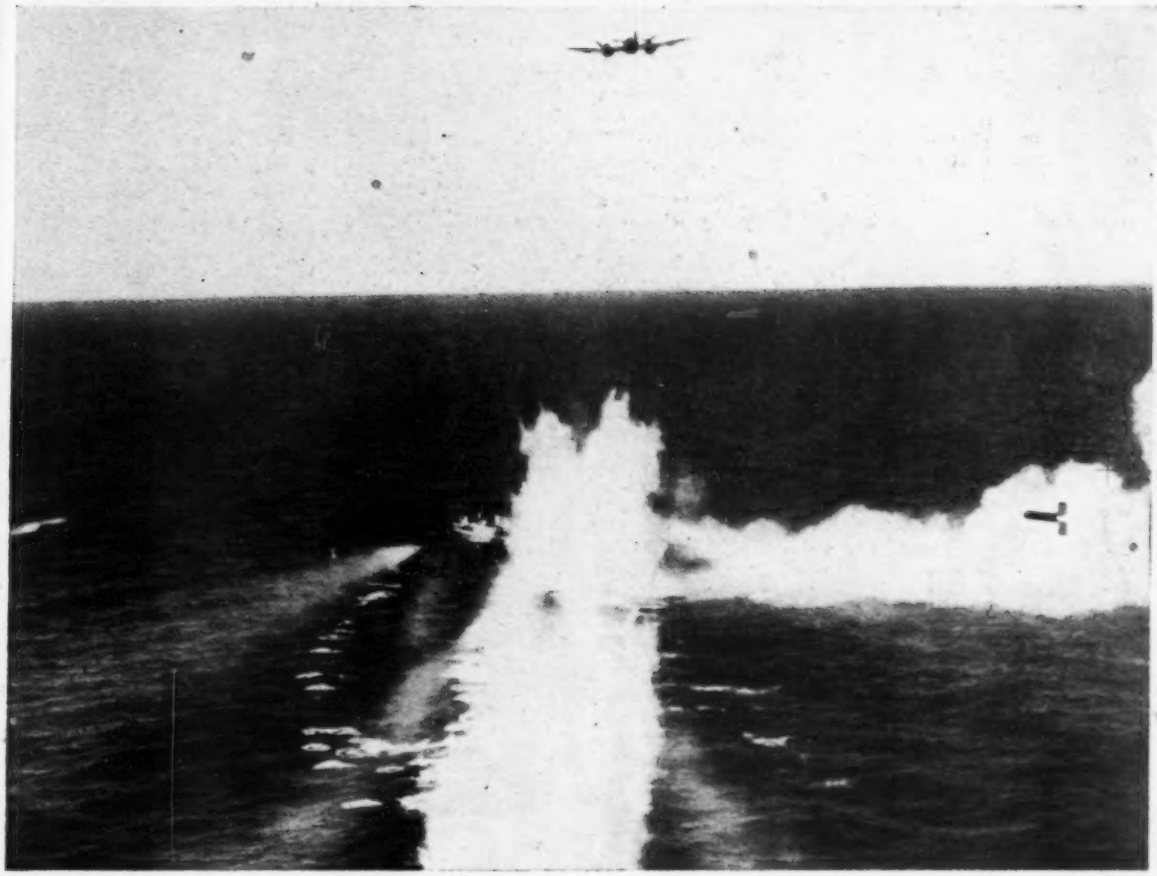
Fundamentally he was all against having great plans by Governments, subsidised by Governments, and used eventually as a method or means of State policy.

"They are generally enterprises whose characteristic is that in no circumstances will anybody be put on the carpet for making a mistake. What we want is a hell of a lot of people who are making a hell of a lot of mistakes. They will get a lot of rebuffs."

WE MOURN A COLLEAGUE

A HIGHLY valued friend has been taken from us by the death of Major A. J. Palmer, O.B.E., at the age of 66. Major Palmer was one of the most remarkable men it has ever been our good fortune to know. He entered the Royal Navy as a boy in 1893, was trained in square-rigged ships, served in the Home, Channel, China and Mediterranean squadrons, and received the China Medal for service during the Boxer Rising. He left the Navy as Petty Officer, 1st Class, in 1907. When war broke out in 1914, although he was over the age limit, he enlisted in the Motor Machine Gun Service as a gunner. He was commissioned in November, 1915, and was one of the first six officers to form the nucleus of what was to become the Royal Tank Corps. He was awarded the O.B.E. for his invention of the tubular sight used on the Hotchkiss gun. He was a Major when he left the Army, and even in this war he "did his bit" in the Upper Thames River Patrol. His eldest son lost his life in the R.A.F. in the present war, and his second son is also in the R.A.F., while his third is with Short Brothers.

To us on *Flight* Major Palmer was always "The Skipper." His knowledge of the Navy and Army was frequently of great help, and he will be greatly missed.



A Beaufighter X rocket attack against an enemy convoy. The Youngman-type bellows-flaps on the Beaufighter are fully down, but the air brake flaps are not extended.

Coastal Command's Share

Enemy Shipping Pounded by Bombs, Torpedoes and Rockets : Attacks Complementary to Work of Strategic and Tactical Air Forces

IT was, of course, our inborn instinct for things nautical which influenced us to build up a strong coastal air force at a time when fighters and yet more fighters must have appeared to be the only answer to the almost insoluble problem of how to beat Germany in the air. Now, even the name Coastal Command is a misnomer, since home-based aircraft patrol as far as the middle of the Atlantic. With the machines which fly from Iceland and Gibraltar there is now an area of some 14 million square miles regularly covered at such intervals that there is no sea area in which it is safe for U-boats to come to the surface and take an easy spell or charge their batteries. Even on moonless nights our Leigh-light aircraft have a habit of suddenly appearing out of the blackness.

Although all this Atlantic patrol work can be looked upon as an offensive attack against enemy submarines, it is, in fact, a defensive part of the big picture.

An entirely offensive part of Coastal Command work is the continuous attack on the coastwise shipping which the enemy attempts to employ from Norway to the Bay of Biscay. It is not very spectacular work, when reduced to figures, but the continual searching and striking in all weathers (but mostly bad) against heavily defended targets, reflects the greatest credit on the personnel under Air Chief Marshal Sir Sholto Douglas' command.

Tactics have had to alter a good deal as the war has progressed. In 1940 Beauforts with torpedoes, and other aircraft doing medium-height bombing, were getting good returns, but as the Germans increased their escort strength the number of hits decreased until a change had to be made. As a counter, the high-speed, low-flying attack with skip-bombing was tried for a while with considerable success. Skip-bombing is somewhat of an art in itself. The bomb must be dropped at such a speed, height and angle that it will bounce off the water and enter the target ship in an horizontal direction. It is, of course, nothing more than a lethal adaptation of the small boy's seaside amusement of skimming stones along the surface of the water.

When this type of attack became too expensive, Coastal Command had, for a while, to return to medium-level bombing and night bombing. With the advent of the torpedo-carrying, cannon-armed Beaufighter X, a new and very successful plan of attack was evolved. First, a number of anti-flak Beaufighters—usually two or three to each ship—would go in, smothering the target with fire from

COASTAL COMMAND'S SHARE

the four 20 mm. cannon and six machine guns which each carry. While the defence was still recovering from the anti-flak attack, the torpedo Beaufighters would slip in and make their precision run.

So effective has this form of attack proved that over half of the shipping which has been attacked since 1942 has been sunk. The seriousness of the position as seen through enemy eyes can be gauged by the fact that it is not uncommon now for Germany to allocate as many as 15 or even 20 escort vessels to protect one transport ship. Most of these escort vessels are of the mine-sweeper class and can be ill spared from their task of sweeping the parachute mines which Bomber Command lay with the utmost regularity.

The Use of Rockets

The use of torpedoes against the small vessels which the Germans specially selected for this coastal supply work was, however, found to be somewhat wasteful. It was for this reason that the rocket projectile-armed aircraft showed itself to great advantage. The present form of attack is this: If the target vessel is of small type, the rockets are used as the primary weapons to sink the ships or their escorts; but if the target vessel is large enough to justify a torpedo attack, then the rockets are used with 20 mm. cannon as secondary anti-flak weapons.

As is usual with all new weapons, a good deal of training is necessary before proficiency is attained, but with the rocket projectiles a high percentage of hits has been obtained from the beginning. In the very first attack, which was against a stranded merchantman, no fewer than six hits were observed. Ten hits were obtained on a large armed trawler, and, in a third attack, 12 direct hits were registered on a medium-sized transport.

The first pilot to use the rockets against enemy shipping was Wing Commander R. H. McConnell, D.F.C., who commanded a Beaufighter squadron equipped with the new weapon. Here is his own account of the attack:—

"The crews were very excited," he said, "and we worked hard to ensure that our first attack should be a success. We began practising on a target in the form of an escort ship marked out on the beach. We soon reached a high degree of accuracy. Then we practised on a splash target, a destroyer towing a buoy, which leaves a wake, and again we became quite proficient. Next we used the explosive rocket on the 'escort ship' marked out on the beach. We could see the streaks as the projectile left the aircraft and then curved downwards to the targets.

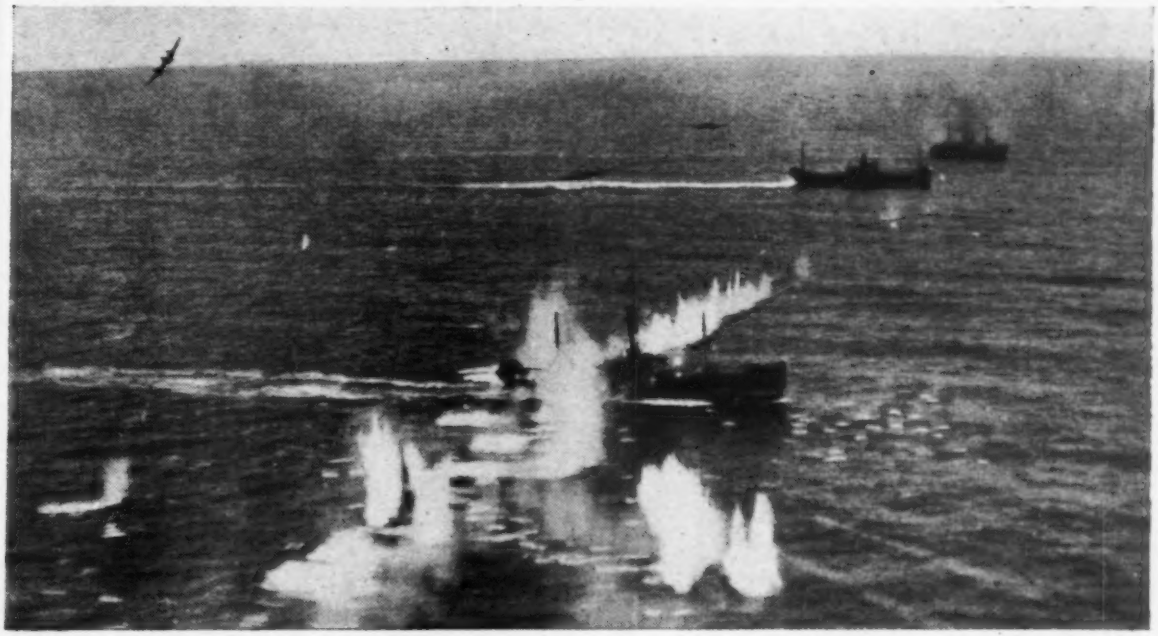
"Our first attack followed a report from a Norwegian pilot of a Mosquito aircraft that a medium-sized enemy merchant vessel had become stranded in a Norwegian fjord just east of North Christiansand, in the direction of Trondheim. We stood by the next day, hoping to be led to the position by the Mosquito but the weather closed-in and we had to wait patiently until it cleared. Owing to the difficulty of maintaining formation in bad weather and of trying to follow the much faster Mosquito, it was decided that the Norwegian pilot should stand behind me in my leading Beaufighter and direct us to the enemy ship.

The First R.P. Action

"On a Sunday, six Beaufighters took off at 6 p.m. Three of us from my squadron were to shoot up the ship with the R.P. while the other three acted as fighter cover. The crews were warned that they had to be very careful when approaching the target owing to the hills surrounding the fjords. They had to approach over the hill, coming in low and firing quickly, passing over the heavily defended entrance to the harbour. The weather was bad at the start but after 15 minutes' flying the aircraft came into a cloudless sky and unlimited visibility.

"I led the formation very low up the Norwegian coast

The art of skip-bombing as shown by a Beechcraft AT-11 practising against a target. Special time-fused bombs are used to ensure explosion in the target and not on impact with the water. Speed, height and angle at the moment of release are important if the bomb is to enter the ship horizontally.



ANTI-FLAK ! A combined rocket and cannon attack to silence and to divert the attention of the enemy anti-aircraft gunners.

COASTAL COMMAND'S SHARE

looking for enemy convoys," said Wing Cdr. McConnell. "Three small escort ships signalled us with an Aldis lamp and we flashed back a reply. They took us for Hun aircraft. Then we flew low over the inhabited islands and could see the islanders in their Sunday clothes taking an evening stroll. Afterwards we came to a field where the Huns were playing football and they ran for their lives.

"At 7.30 p.m. we climbed over the hill to make our attack. The enemy had been firing flak at us for some time but we were too low to be hit. There was a hail of fire from the ack-ack batteries.

"When we had flown over the hill," said the Wing Commander, "we had to be quick in firing or we should have found that we had passed over the enemy vessel. I did not have sufficient time to fire at first, nor did No. 2 aircraft, but No. 3 spotted the ship a little earlier and opened fire with the R.P.

"I turned round up the fjord and made a second attack, scoring hits on the ship. No. 2 aircraft following me, scored several more hits. Meanwhile, the Beaufighters of the other squadron were circling overhead, as protection against enemy fighters. I saw the ship catch fire at the stern and she was burning brightly when two Me 109Fs appeared and attacked No. 3 Beaufighter. At the time the observer of this aircraft was holding a camera over the side taking a picture of the first attack with the R.P. The first he knew that the Me 109Fs were there was when a bullet hit his camera.

"We flew out to sea and managed to shake off the enemy fighters but No. 3 Beaufighter was badly shot up with the undercarriage out of action and a bullet hole in one of the petrol tanks. One of our escort Beaufighters, which was also attacked turned away down the coast and is missing," ended Wing Cdr. McConnell.

The pilot of No. 3 Beaufighter made a successful belly landing on a small runway. His observer was slightly wounded. Next day reconnaissance aircraft reported that the enemy merchant vessel was beached.

That is the account of but one attack out of 3,252 such anti-shipping sorties of all sorts which have been flown during the past six months. What is the effect of all this action on Germany's war effort? In this softening process before D-day strategic and tactical bombing destroy his land communications and these complementary attacks make the only other supply lines unreliable and highly dangerous. Over forty per cent. of Germany's naval personnel is now engaged on escort work and Rotterdam, once the main supply terminus of the Swedish ore trade, is now no longer being used. Any shipping which moves up the coast of Europe—from the Spanish border to North Cape—sneaks along in sight of the shore and, even then, is in continual peril.

SPITFIRE MITCHELL MEMORIAL FUND

A FUND to commemorate the late Mr. R. J. Mitchell, designer of the Spitfire and many other Supermarine types, was inaugurated at a luncheon in London on June 1st. Speeches were made by Viscount Bennett, Air Marshal Sir Leslie Gossage, Air Marshal Sorley, the Lord Mayor of Stoke-on-Trent (Mitchell's birthplace), the Mayor of Southampton, and Mrs. R. J. Mitchell.

Instead of a memorial in stone, the towns of Stoke and Southampton have agreed to found a fund, to be known as the Spitfire Mitchell Memorial Fund, designed to help the youth of the country. A "target" of £250,000 is aimed at, and it is intended to earmark £100,000 for a youth centre at Stoke-on-Trent, and to found 15 scholarships in aeronautics, 10 tenable at University College, Southampton.

President of the Fund is Lady MacRobert, and the Chairman is Sir Francis Joseph. Lord Swaythling has agreed to act as Hon. Treasurer.

The General Secretary is Miss Mary Pitcairn, and Appeal Headquarters of the Fund are at 59, New Oxford Street, London W.C.1, from which address full particulars may be obtained.

By way of illustrating how far-seeing R. J. Mitchell was, Air Marshal Sorley, recalled that it was designed some ten years ago, and that since then its engine power had been increased by 100 per cent., its speed by 35 per cent., its gross weight by 40 per cent., and its rate of climb by 80 per cent. All this had been achieved without fundamental changes in the design.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

THE "MAIL" PLANE

Preventing Unhealthy Reaction

ALTHOUGH I am only a medical student I can foresee several difficulties in the operation of your new "Correspondence" Mail Plane (May 18th).

Chief amongst these is the lubrication of the main rotor axle. It seems to me that if the rotor gets at all stiff the reaction will cause the plane itself to revolve in the opposite direction. May I suggest an inverted bottle of castor oil—that should make it move. "Z. Q."

GUNPOWDER v. PETROL

Laws of Thermo-Dynamics

"DRIVER" has evidently been blinded by the smoke-laden flash of his own gunpowder, which may perhaps explain why he conveniently ignores the laws of thermo-dynamics as propounded by Joule and others which established that energy, or work done, is directly related to the amount of heat generated, i.e., calorific value; thus, one British Thermal Unit is equivalent to 778 ft./lb. of work, while the production of 1 horse-power requires a heat expenditure of 42.44 B.T.U. per minute (assuming 100 per cent. thermal efficiency which, of course, is not achieved in practice).

Now the combustion of gunpowder may be represented by the following chemical equation:—

$$2\,KNO_3 + S + 3C = K_2S + N_2 + 3\,CO_2$$

Using the above as a basis, it can be calculated that 1 lb. of gunpowder produces 5.3 cu. ft. of gas at normal temperature and pressure. However, if we assume a theoretical combustion temperature of 3,400 degrees C.—although in practice this would probably only be about 2,000 degrees C.—this volume becomes 66 cu. ft. (vide Charles' law). The combustion of petrol may be represented as follows:—

$$2\,C_8H_{18} + 25\,O_2 + 94\,N_2 = 16\,CO_2 + 18\,H_2O + 94\,N_2$$

The gases produced by the combustion of 1 lb. of petrol and the theoretical amount of air have a volume of 200 cu. ft. at normal temperature and pressure and at the theoretical combustion temperature of 2,350 degrees C. this becomes 1,720 cu ft.

If "Driver" follows the foregoing he will gather that at the theoretical combustion temperatures, a given weight of petrol has twenty-six times his "piston-pushing value" of an equal weight of gunpowder. Thus a heavy bomber which at present may take off with, say, 14,000 lb. of petrol to carry a sizeable load of bombs to a distant target would, if using gunpowder, have to carry a fuel load of 364,000 lb.! I will leave "Driver" to estimate whether even a Lancaster could cope with this and a bomb load.

As to the question of relative cost, since kerosene would be suitable for the type of power plant suggested by "Driver," this could be reckoned at about 1d. per lb., which I am sure must be only a very small fraction of the cost of gunpowder even when mass-produced on a large scale. A. R. OGSTON.

"Horace" Has His Say

"DRIVER" has suggested that gunpowder is superior to petrol as a fuel (*Flight*, March 16th).

In a criticism of Mr. A. R. Ogston's letter he asks for the relative costs per lb. There is some reason for hoping that 100 octane petrol will be sold to commercial users for 2½d. per lb. after the war. However, let us take 3½d. as the present cost of Pool spirit.

A pound of gunpowder as used in the present austerity shotgun cartridges costs the trade 7s. 3d. per lb., so that with profit and sales tax added the comparable price will be, say, 9s. 9d. per lb., i.e., 36 times as much as petrol. As the energy content of petrol is 15 times that of gunpowder, this means that one shillingsworth of petrol will take us 540 times as far as twelve penn'orth of gunpowder whether we travel by aircraft or motor car. To illustrate:

Our 1927 (late) Morris Minor does just 20 miles on a shillingsworth of petrol. If we installed a gunpower engine it would do 65 yds. on the same expenditure!

Horace, our tame Stressman, says it would require 12 tons of gunpowder and would cost us about £1,350 to propel the Morris from Land's End to John o' Groats. He says we would get into trouble with the police. He says we should have to re-powder our tank, and maybe our noses, every two miles. He does not think we should enjoy sitting on half a keg of gunpowder any more than sitting on a volcano. However, this journey from Land's End to John o' Groats is manifestly impossible as our savings would be burned up by the time we reached Penzance!

Our Stressman says that the expressions used in the previous correspondence, i.e., "calorific value," "piston pushing value," "expansion upon combustion," "heat content" and even "expansive economy" (whatever that might be) mean precisely the same thing. He says they mean the amount of energy available in the fuel, which is surely the measure of its ability to do work.

Horace says that Mr. A. R. Ogston in his very scholarly article is absolutely and completely right. He says that to use gunpowder would be expensive economy. Undoubtedly Aviation is the Coming Thing! W. S. SHACKLETON.

THE FUTURE OF CIVIL AVIATION

Dangers of Race for Supremacy

SINCE we are now starting to make preparations for civil aviation in the post-war world, and since it is the expressed desire of all the peoples of the world that there shall be a lasting peace, it behoves us to consider how best we can serve this aim.

To be quite frank about it, it is obviously in the interests of all readers of *Flight* that this country should generously spend its money and effort in the pursuit of aeronautical research and the maintenance of large up-to-date air transport fleets. Such a course would clearly bring immediate prosperity to the industry and all in any way concerned with aircraft.

But we should ask ourselves whether, in pressing for a large aircraft industry, we were really working for the ultimate peace and general prosperity that mankind as a whole is seeking. There are two aspects of this question: one, that of national prestige; and the other, that of the relative priorities of our various efforts to improve the standard of living of people generally, in accordance with the principles of the Atlantic Charter and the recent Philadelphia Charter.

If we build large fleets of luxurious airliners to compete with similar fleets of other nations, we must be careful to see that we are not drawn into a highly expensive and bitter race between the nations for air supremacy. Such a course, besides being extremely uneconomical, involving the country in vast expenditure, has the danger of being a breeding ground for international ill-feelings which can so easily menace the peace. There are already indications that this race is beginning. Before it is too late, while an active spirit of co-operation exists between the United Nations, brought about by fighting a common enemy, we should do our best to come to some agreement with other countries for the setting up of a rational and economical air transport system for the world. We should do well to study the means of obtaining internationally operated airlines on a regional and world-wide basis.

The other aspect of the matter hinges on whether we are putting the development of aviation too high on our list of priorities for post-war reconstruction. Would we be honestly justified in spending too many millions a year on aeronautical research and airline subsidies, before—to take one example—we had solved the problem of providing adequate nutrition for all our countrymen? Sir John Boyd Orr has told us that just before the war one-third of our population did not obtain a diet adequate for health.

I feel that we aeronautical people, and, indeed, those in other occupations, should periodically pause to consider the social consequences of our work in relation to the whole national and international effort.

In the conclusion to his Wright Brothers lecture, Mr. Farren said he hoped that the work of aeronautical research would be put to better uses than for war, but he also confessed that an absolute scale on which to base the value of his scientific efforts eluded him. All honest and eminent research workers are bound to seek this absolute scale of value, but it is socially desirable that they should also understand the position of their work in relation to all the efforts for national progress, so that they can appreciate why moneys which they would like to see spent on particular items of research may in peacetime be used for other purposes. F. GRINSTED.

SERVICE AVIATION

Distinguished Flying Medal

Flt. Sgt. K. M. PINCOTT, R.A.F.V.R., No. 15 Sqn.—For citation see Act. Flt. Lt. FABIAN, D.F.C. and Bar.
Flt. Sgt. H. ARCHER, R.A.F.V.R., No. 502 Sqn.
Flt. Sgt. C. C. MAWER, R.A.F., No. 201 Sqn.
Flt. Sgt. C. A. SMITH, R.A.F.V.R., No. 404 (R.C.A.F.) Sqn.
Sgt. R. A. BRIARS, R.A.F.V.R., No. 49 Sqn.
Sgt. A. WARD, R.A.F.V.R., No. 49 Sqn.
Sgt. R. MACHIN, R.A.F.V.R., No. 49 Sqn.
Sgt. R. H. HUDSON, R.A.F.V.R., No. 49 Sqn.
Flt. Sgt. A. PRESBURY, R.A.F.V.R., No. 77 Sqn.
Flt. Sgt. F. W. WALTERS, R.A.F., No. 77 Sqn.
Flt. Sgt. A. B. CABLE, R.C.A.F., No. 424 (R.C.A.F.) Sqn.
Flt. Sgt. (now W/O.) J. A. RILEY, R.A.F.V.R., No. 218 Sqn.
Sgt. H. G. BRADY, R.A.F.V.R., No. 619 Sqn.
Flt. Sgt. W. ASPEY, R.A.F.V.R., No. 149 Sqn.
Flt. Sgt. D. MCGREVY, R.A.F.V.R., No. 149 Sqn.
Flt. Sgt. C. H. WALE, R.A.F.V.R., No. 149 Sqn.
Sgt. I. D. HANCOCKS, R.A.F.V.R., No. 77 Sqn.
Sgt. J. M. CHALMERS, R.A.F.V.R., No. 100 Sqn.
Sgt. E. O. GEORGE, R.C.A.F., No. 426 (R.C.A.F.) Sqn.
Sgt. P. MCGIBNEY, R.A.F.V.R., No. 61 Sqn.
Flt. Sgt. S. R. GILLEY, R.A.F.V.R., No. 211 Sqn.
Flt. Sgt. D. E. LOCKLEY, R.A.F.V.R., No. 76 Sqn.
Flt. Sgt. E. E. HUGHES, R.A.A.F., No. 179 Sqn.
Flt. Sgt. W. E. P. WEBB, R.A.F., No. 58 Sqn.
Sgt. V. PETERS, R.A.F.V.R., No. 12 Sqn.
Flt. Sgt. J. CAMPBELL, R.A.F.V.R., No. 239 Sqn.
Sgt. H. GLASS, R.C.A.F., No. 429 (R.C.A.F.) Sqn.
Sgt. E. G. MOORHOUSE, R.A.F.V.R., No. 514 Sqn.
Sgt. A. R. PHILLIPS, R.A.F.V.R., No. 433 (R.C.A.F.) Sqn.
Sgt. K. P. C. WILLIAMS, R.A.F.V.R., No. 550 Sqn.
Flt. Sgt. H. O. BERGER, R.A.F.V.R., No. 101 Sqn.
Flt. Sgt. R. N. BROWN, R.A.F.V.R., No. 9 Sqn.
Flt. Sgt. M. A. COLES, R.A.F.V.R., No. 83 Sqn.
Flt. Sgt. E. CUMMINGS, R.A.F., No. 83 Sqn.
Flt. Sgt. K. J. DAGNALL, R.A.F.V.R., No. 9 Sqn.
Flt. Sgt. A. ELLWOOD, R.A.F.V.R., No. 83 Sqn.
Flt. Sgt. T. J FLOWER, R.A.F., No. 106 Sqn.
Flt. Sgt. A. J. W. HEGGIE, R.A.F.V.R., No. 627 Sqn.
Flt. Sgt. H. C. HIGHET, R.A.F.V.R., No. 83 Sqn.
Flt. Sgt. A. HOLDEN, R.A.F.V.R., No. 44 Sqn.
Flt. Sgt. L. P. HOWELL, R.A.F.V.R., No. 83 Sqn.
Flt. Sgt. M. D. J. PARKINSON, R.A.F.V.R., No. 106 Sqn.
Flt. Sgt. T. F. PARSONS, R.A.F.V.R., No. 9 Sqn.
Flt. Sgt. E. T. M. REES, R.A.F.V.R., No. 625 Sqn.
Flt. Sgt. M. WATSON, R.A.F.V.R., No. 161 Sqn.
Flt. Sgt. G. H. WEBB, R.A.F.V.R., No. 10 Sqn.
Sgt. D. G. E. BROOKES, R.A.F.V.R., No. 77 Sqn.
Sgt. K. W. HEWITT, R.A.F.V.R., No. 460 (R.A.A.F.) Sqn.
Sgt. L. J. NASH, R.A.F.V.R., No. 625 Sqn.
Sgt. P. W. VAGGS, R.A.F., No. 630 Sqn.
Sgt. K. WRIGHT, R.A.F.V.R., No. 100 Sqn.

THE KING has been graciously pleased to approve the following award, with effect from April 27th, 1944, in recognition of gallantry displayed in flying operations against the enemy in the South-West Pacific area:—

Distinguished Flying Cross

Flt. Lt. A. MILLER-RANDLE, R.A.A.F.

THE KING has been graciously pleased to approve the following awards in recognition of gallant and distinguished service:—

Bar to Military Cross

Flt. Lt. F. F. E. YEO-THOMAS, M.C., R.A.F.V.R.

Military Cross

Flt. Lt. O. L. S. PHILPOT, D.F.C., R.A.F.V.R
Flt. Lt. A. F. MCSWEYN, R.A.A.F.
Flt. Lt. H. D. WARDLE, R.A.F.O.

Military Medal

Sgt. A. R. COTTLE, R.A.F.V.R.

Roll of Honour

Casualty Communiqué No. 391.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 104 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—P/O. S. C. Atcheson; Sgt. J. H. Bone; Flt. Lt. C. F. Boxall; Sgt. L. D. Blackford; Sgt. W. Bruce; Sgt. G. E. Collins; Sgt. A. H. Estcourte; Flt. Sgt. F. J. Everett; Flt. Sgt. J. Greenhalgh; Sgt. T. R. Hewitt; F/O. H. T. Jackson; P/O. A. P. McCall; Sgt. J. W. Naylor; Sgt. W. H. Ramsay; Sgt. J. H. Riddle; Flt. Sgt. J. V. Spring; Sgt. B. H. M. Thomas; Sgt. L. H. D. Warren; Sgt. F. S. Weaver.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. E. W. J. Amor; F/O. R. H. Andrews; Sgt. F. W. A. Bates; Sgt. A. E. Betts; Sgt. T. R. Crowther; Sgt. D. L. Dean; Flt. Sgt. R. Fall; Flt. Sgt. H. E. Hall; F/O. P. A. Levy; Sgt. W. S. Lynn; Sgt. J. L. Morgan; Sgt. W. C. Thomas; Sgt. W. C. M. Thomas.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. M. C. Anastassiades; F/O. D. J. Anderson; Sgt. W. Bailey; P/O. A. J. Beazleigh; Flt. Sgt. S. E. Birkett; F/O. A. P. Blackie; F/O. F. T. Brown, D.F.C.; Sgt. R. Burnett; F/O. W. J. Cameron; Flt. Sgt. T. Chadwick; Sgt. F. S. C. Cook; Sgt. J. G. K. Dean; Sgt. M. Emmerson; Sgt. D. Enoch; F/O. R. N. Farrow; Flt. Sgt. J. D. Flyn; Sgt. E. C. Fox; Sgt. P. C. Goodyear; Flt. Lt. H. Gore; Sgt. G. E. Harmes; Sgt. E. F. Harris; F/O. K. C. Hollinson; Sgt. P. Holloway; Act. Flt. Lt. C. H. J. Hunt; Sgt. A. Hunter; Sgt. F. W. Jeffrey; Sgt. J. G. Jones; Flt. Sgt. B. G. Kemp; Sgt. A. T. Lees; Sgt. F. Lennard; F/O. G. Lockie; Sgt. T. H. Loke; Sgt. H. Machin; F/O. V. J. Markey; Sgt. V. J. Merefield; F/O. J. G. Millar; Sgt. E. R. Moore; Flt. Sgt. R. O'Hara Murray; Sgt. G. A. Purcell; Sgt. H. G. J. H. Read; Sgt. F. J. Richards; Sgt. F. J. Richardson; Sgt. D. C. Robertson; P/O. G. A. Scarcliffe; F/O. W. T. Shannon; Flt. Lt. J. Small; F/O. A. Smith; P/O. G. W. Snelling; Sgt. W. J. Spence; P/O. R. Spooner; Act. Flt. Lt. P. J. Stone, D.F.C.; Sgt. A. E. Taylor; Sgt. R. Webb; Sgt. W. D. Whitfield.

WOUNDED OR INJURED IN ACTION.—Sgt. R. L. Ludlow; Flt. Lt. T. W. Robinson.

MISSING, BELIEVED KILLED IN ACTION.—P/O. J. H. Dempsey.

MISSING.—Sgt. J. N. Andrew; Sgt. A. J. Armstrong; Sgt. P. Atha; Sgt. K. A. Attwood; P/O. J. Barclay; Sgt. F. G. S. Bilney; Sgt. D. B. Birbeck; Sgt. H. J. Bowen; Sgt. W. Bowers; Flt. Sgt. J. A. Bowler; Sgt. C. A. Brookes; F/O. P. C. R. Brown; Sgt. E. Buckland; Sgt. A. Cantle-Jones; Act. Sqn. Ldr. C. R. Clark; Sgt. R. Clegg; P/O. R. E. Cooper; Sgt. P. J. Copus; Flt. Lt. J. S. G. Crawford; Sgt. A. Currie; P/O. H. N. Davies; Sgt. G. Donald; Sgt. R. Eddison; F/O. R. F. Emery; Flt. Sgt. T. T. Evans; Flt. Sgt. R. Fairplay; Sgt. E. G. Fidler; Sgt. D. J. Findlay; Flt. Sgt. D. Francis; Sgt. P. J. Gallacher; P/O. D. J. Gigger; Sgt. N. Graham; Sgt. W. J. Green; P/O. P. H. Hamby; Sgt. G. K. Hardwick; Sgt. W. E. Hardy; Sgt. H. G. Harper; Sgt. K. F. Harris; P/O. B. S. Harrison; Flt. Sgt. R. Hinde; Act. Flt. Lt. K. T. S. Holmes; Sgt. W. Holmes; Sgt. R. Hoole; Sgt. R. E. James; F/O. J. J. Knowles; Sgt. C. G. Lander; Sgt. J. J. Lapes; F/O. K. A. Leonard; Sgt. S. A. Lewis; F/O. P. A. Lockton; Flt. Sgt. A. Lunt; Flt. Sgt. T. C. McEneaney; Flt. Sgt. A. McFadyen; P/O. J. C. McLeish; Sgt. D. W. McMillan, D.F.M.; Sgt. R. F. McNeil; Sgt. G. P. Marley; Flt. Sgt. F. J. Marriott; Flt. Sgt. W. F. Martin; Sgt. S. J. Mead; Act. Flt. Lt. W. A. Meyer, D.F.C.; Flt. Sgt L. V. Moran; Sgt. W. A. Munday; Sgt. K. E. Oclee; Sgt. R. Pead; Flt. Sgt. H. W. Phillips; P/O. R. C. Pike, D.F.M.; Sgt. J. R. Powell; Sgt. H. P. Riddle; Sgt. W. B. Robertson; Flt. Sgt. W. Rose; Sgt. R. G. Ryder; Flt. Sgt. A. E. Roberts; Sgt. R. A. L. Saunders; Flt. Sgt. B. O. Savage; Sgt. J. Shaw; Flt. Sgt. T. R. Shaw; P/O. H. J. W. Smith; Sgt. N. A. Smith; Sgt. S. Smith; Sgt. W. McK. Smith; Flt. Sgt. G. C. Spurden; Act. Flt. Lt. W. J. Stammers; Act. Flt. Lt. B. J. Starie, D.F.C.; Sgt. D. W. Stead; Sgt. G. R. Stewart; Flt. Sgt. G. Tipping; Sgt. S. W. Tolley; Sgt. S. Wasson; P/O. T. W. Waugh; Flt. Sgt. J. C. K. Webb; Sgt. J. Wilby; Sgt. J. B. Wise; Sgt. F. S. Witcher.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. R. Rhodes.

KILLED ON ACTIVE SERVICE.—Sgt. L. S. Flamer-Caldera; P/O. J. Gilliard; F/O. R. F. Gore; F/O. D. R. Hale; A/C.2 D. J. Hart; L.A/C. R. Luck; A/C.2 P. J. Skelton; P/O. R. L. Stewart; P/O. K. H. Wright.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. P. W. Davis; Sgt. J. Haworth; Sgt. D. H. Head; Sgt. G. D. McCullock; Sgt. W. E. Pearce; Sgt. R. Raisbeck; P/O. C. H. Seymour.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. T. W. Arundel; F/O. W. M. Bruckshaw; Flt. Sgt. L. G. Buck; L.A/C. B. E. Mason; Flt. Lt. P. F. Sewell.

DIED ON ACTIVE SERVICE.—L.A/C. W. A. Atherden; Flt. Lt. J. Beeson; A/C.2 J. T. Clayton; A/C.1 J. Kelly; L.A/C. J. W. Reid.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. W. Docherty; Sgt. J. C. Jossa; F/O. L. A. Prickett.

RUSSIAN HONOUR: M. Gusev, the Soviet Ambassador, presenting the Order of Suvorov to Air Chief Marshal Sir Arthur Harris. This decoration is Russia's highest military honour.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—Sgt. C. A. Collins.
DIED ON ACTIVE SERVICE.—L.A/CW. J. Churchill; A/CW.2 B. M. Hitchon; Cpl. M. E. Stevens.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Sgt. P. V. Bashford; Flt. Sgt. P. Kennedy.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. B. Donohoe; F/O. B. P. Jay; F/O. W. F. Spier; Flt. Sgt. K. Van Waning.

MISSING.—Flt. Sgt. J. H. Bell; Flt. Sgt. J. MacA. Benzie; P/O. R. E. Butt; P/O. D. A. Carter; F/O. K. C. Dyer; P/O. K. W. Evans; Flt. Sgt. G. A. Johnston; W/O. R. J. King; W/O. H. Krone; Flt. Sgt. S. J. F. Palmer; P/O. G. F. Parkinson; P/O. J. H. Porter; F/O. J. Roberts; Flt. Sgt. R. C. Sherwood; Flt. Sgt. R. S. Smith; P/O. P. A. Thomson; P/O. K. F. Withers.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. P. E. Balderston; P/O. J. P. Dockerill; F/O. D. C. Fennah; Sgt. A. D. Gordon; P/O. M. P. Hall; P/O. N. D. Hayes; P/O. R. W. Hudson; Sgt. R. D. McCullagh; Sgt. L. G. McKenzie; Sgt. R. M. McLeod; W/O. H. E. Mayer; P/O. J. E. Monohan; Flt. Sgt. N. R. Morrison; Sgt. J. W. Robertson; Sgt. R. Zeidel.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. E. E. Case.

MISSING, BELIEVED KILLED IN ACTION.—F/O K. A. Cole; Flt. Lt. H. L. Heimbecker; Flt. Sgt. J. H. G. Senecal.

MISSING.—P/O. A. McA. Barrowman; Sgt. E. C. Brewer; Sgt. J. B. Ewen; Flt. Lt. A. B. Fyfe; P/O. B. E. Galbraith; W/O. J. A. Hillman; Flt. Sgt. D. B. Hyde; W/O. C. H. McIlwain; Sgt. W. V. Moss; Sgt. W. F. Nicholls; F/O. I. H. Nicolson; Flt. Sgt. R. J. Renneberg; W/O. E. W. Strauss.

KILLED ON ACTIVE SERVICE.—F/O. N. J. Baron; P/O. M. A. Martin; P/O. H. M. Stewart; Sqn. Ldr. W. W. Strachan, D.F.C.; F/O. R. C. Stuart.

PREVIOUSLY REPORTED MISSING, BELIEVED

SERVICE AVIATION

KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. T. A. Herron.
PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. F. W. Forster.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. R. H. Nelson.
PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. L. J. Gwynne; F/O. J. V. Hawkins; Flt. Sgt. D. J. Tickle.
MISSING.—P/O. J. L. Childs; W/O. N. J. Trewavas.

South African Air Force

MISSING.—Capt. P. H. Bosch.
KILLED ON ACTIVE SERVICE.—P. A. G. Bates; Lt. J. M. MacIndoe.
PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED ON ACTIVE SERVICE.—Lt. H. F. Harvey.

Casualty Communique No. 392

Of the names in this list 96 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. A. W. Aiston; Sgt. H. A. Baxter; Sgt. J. A. Coates; Flt. Sgt. W. Cowern; Sgt. J. D. Dadswell; Sgt. R. J. Fettis; Sgt. D. Hewit; Sgt. J. G. B. Jameson; Sgt. S. H. Jenkins; Sgt. T. H. Jones; Sgt. D. McA. Munro; Flt. Sgt. K. G. Redford.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. J. E. A. Beecher; Sgt. R. A. Blackburn; Flt. Sgt. A. McA. McKinlay; Sgt. R. B. Perry; Sgt. D. Pickersgill; Act. Wing Cdr. T. P. Pugh, D.F.C.; Flt. Sgt. E. Stow; Sgt. L. Turner; P/O. W. T. Waitt.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. W. K. Ambrose; Sgt. C. J. Bailey; F/O. L. Bays; F/O A. H. Blazer; Sgt. J. A. Bright; F/O. G. W. F. Button; F/O. P. I. Calcutt; Act. Flt. Lt. J. N. Cartwright; Sgt. W. C. Colley; Sgt. S. R. Connell; Sgt. J. Conway; Sgt. V. B. Crapper; Sgt. A. F. S. Day; Sgt. R. B. Farmery; F/O. J. D. S. Goldring; F/O. G. C. Hamilton; Flt. Lt. W. J. Hein; Flt. Lt. A. J. Hodgkinson, D.S.O., D.F.C.; Sgt. W. E. Jackson; Sgt. J. A. J. Jarman; P/O. E. F. V. Kidd; F/O. S. Lees; Flt. Sgt. T. A. MacQuarie; Flt. Sgt. C. Mather; Sgt. F. H. Mitchell; Sgt. R. H. Morgan; Sgt. D. J. Parkin; P/O. G. B. P. Patterson; Sgt. F. W. A. Powell; Sgt. D. H. Read; Sgt. W. J. Rees; Sgt. M. Scheddle; P/O. J. O. Shone; P/O. H. C. Stevenson; Flt. Sgt. A. C. Temple; Flt. Sgt. A. Tomlinson; Sgt. J. F. A. Trehearn; Sgt. J. Wardle; Sgt. C. G. Whiteley; Flt. Sgt. A. Williams; Sgt. G. P. Woodruffe; Sgt. E. E. Wright.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. E. B. Caton.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. J. H. Davis; Flt. Sgt. E. F. D. Shafto.

MISSING.—Flt. Sgt. M. Adder; Flt. Sgt. P. H. Armstrong; F/O C. E. Austin; F/O. D. R. Barham; P/O. L. A. Barnes; F/O. J. R. Berrington; Sgt. P. E. Bethell; Sgt. A. E. Bullivant; Sgt. M. B. Carroll; Sgt. P. R. Cattrall; Sgt. J. E. Charnock; Sgt. G. Clark; F/O. L. F. Clarke; Sgt. R. Clewer; Flt. Sgt. D. A. Cole; Sgt. G. Cosgrove; Sgt. G. Crabb; F/O. W. Cross; Sgt. D. V. Davies; Act. Flt. Sgt. A. Dawson; Sgt. T. R. Dennis; Act. Flt. Lt. J. G. Dippie; Sgt. M. Duckworth; Sgt. R. J. H. Easter; Sgt. H. Ellison; Sqn. Ldr. L. H. Eno, D.F.C.; Sgt. J. O. Everett; Sgt. V. Favager; Sgt. T. A. Fox; Sgt. G. H. Freeman; F/O. T. H. Fynn; Sgt. D. Gibson; Sgt. N. J. Goss; Sgt. M. E. Gregg; F/O. D. M. Griffiths; Flt. Sgt. L. Hall; Sgt. W. F. Hammond; Sgt. E. C. E. Harris; Flt. Sgt. C. E. Harvey; Flt. Sgt. H. O. Hill; Flt. Sgt. F. J. Hobbs; Sgt. W. C. Jack; Sgt. R. Johnson; Sgt. M. Y. E. Kalms; Flt. Sgt. D. J. Kilner; Sgt. E. R. Lee; Sgt. H. M. McAllister; F/O. R. A. Milne; Sgt. R. Nash; Sgt. D. D. Orme; Sgt. T. Y. Owen; Sgt. K. E. Peake; Sgt. G. E. Plowman; Sgt. H. G. Price; Sgt. A. G. Redman; F/O. F. J. Reid; P/O. H. J. Rich; Sgt. C. Roberts; P/O. K. Rodbourne; Sgt. J. Sagar; Sgt. E. G. Sears; Sgt. E. Shatz; Sgt. C. F. Smallwood; Sgt. F. E. A. Smith; Flt. Sgt. R. C. Smith; Flt. Lt. E. A. Snow; Act. Flt. Lt. R. G. Spicer; Sgt. H. D. Steele; Flt. Sgt. J. A. Taylor; P/O. H. F. Tomalin; P/O. B. S. Uppington; Flt. Sgt. A. V. Verdon; Sgt. K. A. Walker; Act. Wing Cdr. V. J. Wheeler, M.C., D.F.C.; Flt. Sgt. D. White; Sgt. A. H. Wilkinson; Sgt. G. H. Witney; F/O. J. H. Wyborn.

KILLED ON ACTIVE SERVICE.—Sgt. T. H. Allan; Act. Flt. Lt. D. A. Ashton; Flt. Lt. B. J. Balchin; F/O. A. D. Buchanan; Flt. Lt. D. M. Campbell; Sgt. P. Cassell; Flt. Sgt. D. J. Chandler; F/O. D. W. Crouch; Act. Flt. Lt. K. S. Dodrill, D.F.C.; Sgt. F. E. R. Evans; Flt. Sgt. J. G. Flockhart; Flt. Sgt. F. L. Fuller; Sgt. S. Greig; Cpl. J. Harris; P/O. J. E. Heywood; P/O. D. Huddleston; Flt. Sgt. R. Johnston; Sgt. J. A. Lang; Flt. Lt. C. S. Martin; Sgt. B. Morgan; Sgt. A. Peterken; Sgt. L. C. M. Race; Sgt. A. W. H. Rowley; Sgt. P. Sears; Sgt. K. Stubbs.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. L. A. Baker; Sgt. R. C. M. Parris.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. R. E. P. West.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. W. J. Foxley; Sgt. F. G. Swain; Sgt. S. A. Waller.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. J. H. Dacre; Sgt. E. Small.

DIED ON ACTIVE SERVICE.—A/C.1 A. T. Addicott; F/O. J. Alderson-Hiller; F/O. E. B. Butler; L.A/C. W. F. Dean; L.A/C. M. Digby; Flt. Sgt. K. G. Peers; A/C.2 H. A. J. Prime; Flt. Lt. R. Rogers.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. W. H. Adams; Sgt. F. H. Andrews; A/C.2 L. G. Hopkins; A/C.2 R. W. McGarvey; L.A/C. J. McPherson; Sgt. G. B. Mowbray; Flt. Sgt. G. L. Renshaw; P/O. W. McC. Sinclair; Sgt. R. E. Stokes; W/O. F. Turvil.

Royal Australian Air Force

KILLED IN ACTION.—P/O W. A. Graham; Sgt. A. S. Humphreys.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—W/O. N. A. P. Kane-Maguire; Flt. Sgt. J. C. Perry.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. MacQ J. Campbell.

MISSING.—W/O. G. E. Doggett; Act. Flt. Lt. A. K. D. Fell; F/O. L. A. Gream; Flt. Sgt. J. Lambert; F/O. W. H. Lees; W/O. F. E. Muller; Flt. Sgt. E. S. Newell; Flt. Sgt. E. J. Philipson; F/O. K. M. Watkins; Flt. Sgt. M. D. Watson.

KILLED ON ACTIVE SERVICE.—W/O. B. W. Gorman.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. J. N. Gunnis.

Royal Canadian Air Force

KILLED IN ACTION.—W/O. H. C. Bell; Flt. Sgt. J. P. Bulger; W/O. G. Ivey; F/O R. R. Jones; P/O. F. W. Lerl.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—W/O. E. C. Champion; Flt. Sgt. W. H. Davey; Flt. Lt. D. M. Grant, D.F.C.; Flt. Sgt. E. Johnson; Sgt. W. W. Kozicki; Flt. Sgt. J. E. Paquet; W/O. J. L. Perrin; Sgt. P. L. J. M. Quenet; Flt. Sgt. R. Ranger.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. J. Bennett; Sgt. N. C. Brown; Flt. Sgt. W. McI. Brown; F/O. V. J. Jewell; Sgt. G. R. Jordan; Wing Cdr. H. W. Kerby; Flt. Sgt. H. S. Martin; P/O. P. S. Murphy; Flt. Sgt. R. E. Paddison; F/O. F. J. Parsons; Flt. Sgt. H. M. Porteous; Flt. Sgt. W. J. Poulin; Flt. Sgt. C. Robinson; Flt. Sgt. K. E. Schlegel.

Night fighter pilots being briefed by an army searchlight officer before take-off. Many raiders have already been destroyed through searchlight-aided interceptions.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. G. E. Hexter.

MISSING.—F/O. R. B. Black; Flt Sgt. J. P. Brooks; F/O. D. H. Calder; F/O. A. C. Colville; Sgt. W. P. Dunbar; P/O. C. I. Elsley; W/O. A. McC. Freeman; Sgt. W. H. O. Heidman; W/O. A. C. K. Hodson; F/O. R. H. Jackson; Sgt. I. W. Martin; P/O. J. F. O'Dowda; Sgt. J. H. Overholt; F/O. K. T. Penkuri; Sgt. L. J. Pugh; F/O. W. V. F. Reid; W/O. C. A. Ritchie; Flt. Sgt. R. Sharp; F/O. M. A. Siddons; Flt. Sgt. A. G. S. Simard; Sgt. W. F. Sutherland; Flt. Sgt. H. B. Thompson; W/O. G. W. Wildfong; P/O. L. A. Wry; Sgt. L. E. Yeo; F/O. H. K. Young.

KILLED ON ACTIVE SERVICE.—Sgt. J. L. P. D. Carrier; Sgt. J. J. O. Cournoyer; Flt. Sgt. F. R. Dionne; W/O. A. J. P. Normandeau; Flt. Sgt. R. A. Pelletier; Flt. Lt. F. G. Statham; F/O. R. A. Walld.

Royal New Zealand Air Force

KILLED IN ACTION.—W/O. K. E. W. McCombie.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. E. V. Potter.

MISSING.—Flt. Sgt. K. Drummond; Flt. Sgt. G. E. Hamilton.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. A. H. Lister; P/O. W. A. Moore.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. H. W. Thoms.

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Lt. L. L. Jacques-Houssa; Lt. H. W. Nottingham.

WOUNDED OR INJURED IN ACTION.—2/Lt. M. B. Charlton; 2/Lt. T. D. Couzens; W/O. V. A. Schroenn.

KILLED ON ACTIVE SERVICE.—Lt. H. E. Ratcliff.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Capt. D. R. C. Main.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. D. E. Bruyn.

Official Corrections

Casualty Communiqué No. 387.
Under "MISSING" delete F/O. F. J. Thompson.
Casualty Communiqué No. 388.
Under "MISSING" delete Sgt. G. W. Green and Act. Flt. Sgt. J. Williams.
R.A.A.F.—Under "MISSING" delete F/O. C. E. Melin.
R.C.A.F.—Under "KILLED IN ACTION," for Flt. Sgt. R. Sirluck read W/O. R. Sirluck. Under "MISSING" delete Sgt. H. E. Gammon.
Casualty Communiqué No. 389.
Under "MISSING" delete Flt. Sgt. G. F. Bishop and F/O. A. Ganderton.
R.A.A.F., under "MISSING," delete Flt. Sgt. F. J. Brown and W/O. J. D. Seymour.
Casualty Communiqué No. 390.
Under "MISSING" delete Sgt. J. T. Cashmore, and for Sgt. P. W. Templer read Flt. Sgt. P. W. Templer.
R.A.A.F., under "MISSING" delete Flt. Sgt. R. M. Wilson.